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BRITISH ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE,
LIVERPOOL, 1923.

EXCURSIONS
AND
VISITS TO WORKS

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BRITISH ASSOCIATION
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LIVERPOOL, 1923

EXCURSIONS
AND
VISITS TO WORKS

EDITED BY
EDWIN THOMPSON



SMITHSONIAN INSTITUTION

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PREFACE

How pleasant and refreshing it is, when organising a number of Excursions and Visits to Works, to find everybody so willing and eager to do everything possible to make them a success.

Such has been the experience when arranging the Excursions and Visits to Works for the occasion of the Meeting of the British Association for the Advancement of Science.

The very cordial thanks of the Local Committee of the British Association for the Advancement of Science are due to the many manufacturers who have so kindly thrown open their Works to those who wish to visit them, also to those gentlemen who have offered their services as leaders and to those who have assisted in making the necessary arrangements.

Apart from visits to works, there are visits to several liners, by the kind invitation of the Booth Steamship Co., Ltd., The Cunard Steamship Co., Ltd., and The White Star Line, and their hospitality is very greatly appreciated.

It will be noticed that after the Meeting there is to be a visit to the Isle of Man, extending over the week-end. It is hoped that it will be well attended, as arrangements have been made to provide an interesting and instructive visit of five days.

On looking through the contents, it will be seen that the Excursions have been arranged to include as varied a combination of interests as possible, so that those who are able to take part in them will perhaps leave Liverpool after the Meeting with an increased knowledge of the surrounding country, and also of the many industries carried on in the vicinity.

EDWIN THOMPSON,

Joint Local Hon. Secretary.

MANESTY BUILDINGS
COLLEGE LANE,
LIVERPOOL.

September, 1923.

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THURSDAY, SEPTEMBER 13TH.

No. 1.

**BRYANT & MAY LTD.,
THE DIAMOND MATCH WORKS.**

Limited to 50.

Leaders.—W. G. WRIGHT, Esq. (Manager, Messrs.
Bryant & May, Ltd.)

J. R. HOBHOUSE, Esq. (for the British
Association).

An early start has to be made because many of the most interesting processes at these Works stop down before 3 o'clock in the afternoon, so it is hoped that visitors will assemble promptly on time.

The party will leave St. George's Hall Plateau by special motor bus at 1.45 p.m., and will leave the Works when they close at 4 o'clock and arrive back at St. George's Hall before 4-30.

THE DIAMOND MATCH WORKS.

THE first thing the visitor will see is the Timber Yard, and when one realises that Bryant and May have an output of over 94,000,000 matches a year one is not astonished that it looks rather like a Timber Merchant's Yard instead of a Match Factory. Aspen trees form the bulk of the timber. The log enters the Saw Mill and is cut up into convenient lengths of about 30 inches, the bark is rough shaven from the logs, and then they go up a conveyor to the Peeling Room. The portion of the log is gripped at both ends and placed on the peeling or veneering machine. As it revolves long thin veneers of wood are peeled off. At first, before the log is evenly rounded by the knife, short useless slices come away, but in a second or

two the strips grow longer until the assistants can take hold of them and run them along a counter. The veneers are piled up one on top of another, and one end of these layers is fed into a machine and they are cut by a guillotine into the proper lengths. This machine turns out 56,000 match splints a minute. These splints are then boiled in great tanks for five minutes in the impregnating solution, and for the next two hours they are rolled round and round drums, being polished and dried. The splints are then piled into trays, taken to the Match Room, fed into a match machine and are punched into a series of fine holes in a slow moving flexible cast iron band. As this revolves the splints pass through a bath of paraffin wax, and then over a roller covered with the igniting composition, and thus pick up their heads. They are then dried and are automatically filled into the boxes. The only point at which the human element comes in is when they pass the Inspector who detects at once any irregularity or any imperfect filling. This is very briefly, a description of the Match making.

The Visitors will see the manufacture of the match boxes themselves, and the printing. They will also see how the striking surface is put on the boxes. Finally, the completed match boxes will be seen as they are wrapped up and sent to the Warehouse for distribution.

No. 2.**W. & R. JACOB & CO. LTD. BISCUIT WORKS.**

Limited to 200.

Leaders.—ALBERT E. JACOB, Esq., J.P., Managing Director.

Capt. C. W. JACOB, Director.

W. D. HUNTON, Esq., Director

Professor W. H. ROBERTS (for the British Association).

It is an honourable understanding on the part of the visitors that none of them are directly connected with the manufacture of Biscuits.

Time Table.—The party will assemble on the Plateau of St. George's Hall at 2.30, and will leave by motor bus for the Works at Aintree.

Messrs. W. & R. Jacob & Co. Ltd. have kindly invited the party to tea after the visit, and at 5 p.m. motor buses will be ready to convey the party back.

THE Firm of W. & R. Jacob & Co. Ltd. was founded in Dublin in the year 1851, and for a generation its trade was mainly confined to Ireland. In the year 1880, however, their great original speciality, the Cream Cracker, was launched, and achieved an immediate and unprecedented success, becoming an article of daily household use, first in the home market and ultimately in almost every part of the world. The Dublin factory became quite inadequate to meet the demand, and the Aintree factory was started to supplement the output. A site of thirty acres on the outskirts of Liverpool was secured and a factory laid out on the most modern lines, with all the latest improvements for mass production of biscuits on an extensive scale. The new factory was started in 1914, and enabled the firm during the Great War to deal with the enormous

demand of the Army and Navy Canteens in every part of the world. The building of a second factory at Liverpool became necessary, its construction providing employment for many demobilised men. The firm took back into their service every sailor and soldier previously employed who desired reinstatement, and in addition found room for the employment of a large number of partially disabled men. The separation of the Exchequers of Great Britain and Ireland necessitated the formation of a separate company for Great Britain, under the name of W. & R. Jacob & Co. (Liverpool) Ltd., manufacturing for the British market, and through its numerous depôts and widespread system of motor deliveries distributing the products of the Dublin and Liverpool factories in every town and village throughout Great Britain. The situation and lay-out of the Liverpool factory enables the firm to provide to the fullest extent for the health and welfare of the workers, and a visit to the factory provides an object lesson of how to combine industrial development with efficiency, health, and happiness. The idea of the garden factory is essentially modern, and Jacob's up-to-date factory at Aintree finds a suitable setting in the beautiful lawns and flower beds with which it is surrounded. Instead of an ugly wall or fence it is bounded on the Long Lane side by a rustic bank covered with a fine gorse hedge, which in its season is a blaze of gold.

There are extensive playing fields for the workers, whose convenience is further studied in the provision of a spacious and well-appointed Canteen, where meals are provided at cost price. The health of the workers is ensured by the attendance of a qualified medical practitioner, who examines all the workers on admission and watches over the maintenance of their physical welfare at the cost of the firm.

There is also a dental surgery where the teeth of the workers are attended to regularly—all extractions and fillings being free, and artificial teeth provided at cost price.

There is an efficient welfare staff, presided over by a Sister, who looks after the female employees, and sees that the conditions of their work, rest and recreation are such as to develop to the full the health and contentment of those employed in the factory.

Facilities for Sports and Games are provided in the grounds when the weather is suitable, and the long winter nights are enlivened with Dances and Whist Drives.

The hours worked are 47 per week, and the wages are above the standard usually paid in the biscuit industry.

The Firm is convinced from actual experience that the expense of looking after the health and happiness of the workers is fully justified by the excellent results obtained in the output of the factory. Mass production by a healthy and efficient staff ensures a profitable market for the biscuits turned out at the Works, and accounts for the widespread popularity of Jacob's biscuits in every part of the world.

No. 3.

W. VERNON & SONS LTD., FLOUR MILLS.

Limited to 100.

Leaders.—NORMAN VERNON, Esq.

E. GABRIEL JONES, Esq., M.Sc., F.I.C. (for the British Association).

MEMBERS of the British Association intending to visit Messrs. W. Vernon & Sons' Mill, at Seacombe, on September 13th, will travel by the 2 o'clock boat to Seacombe, where special motor buses will be waiting.

Visitors on arriving at the Mill will be conducted to the Engine Room and Electrical Power Room. The points of interest here are the 1,500 H.P. Marine Type triple expansion Engine, by Victor Coats & Company, of Belfast, steam recording machine and the latest up-to-date electrical appliances in the power room, and the coal Silos.

From thence the visitors will be taken through to the wheat silos, the capacity of which is about 6,500 tons. The points of interest here are the automatic weighing machine (Avery) at the Intake Elevator and the Mixing Machines to the Conveyor.

They will then proceed to the Wheat Cleaning Department. Here the cleaning and conditioning of the wheat ready for grinding is in process, and should provide great interest to all who have not seen this process before. The amount of impurity that is to be extracted before the wheat is ready to go on the Mill to be ground will be a revelation. From thence they will proceed to the Mill proper, where they will see the roll grinding machines on the first floor; Purifier on the second floor; Scalpers on the third floor and Silks on the fourth floor; and from thence to the Basement, where they will see the Bran Roller Machines.

They will then proceed to the Packing Department, where all the latest appliances are in vogue for the packing of the products. Then to the Warehouse and Storage, where the latest devices in handling and delivering the goods are in operation. The points of interest here are the spiral delivery shoots, delivery band, and the automatic checker (checking the number of packages going to the barge or steamer), the electric piler, or loading machine, man elevator, and the barrel packing arrangements: and also the sack shed, where all the latest devices for making sacks merchantable and clean are in operation. The 'Star' shaking machine for shaking sacks and the 'Robinsons' beater machine for beating sacks are in use.

Other points of interest are the Bakehouse, showing the electrical ovens and the electrical dough mixing machines. The Laundry, which is driven by electricity for the washing of overalls, etc., the electric capstans on the quay for hauling railway waggons, the loco. engine and motor sheds; and last, but not least, the Model Cottages in Vernon Avenue.

Messrs. Vernon have kindly invited the party to afternoon tea during the visit.

No. 4.**WHITE STAR LINER R.M.S. 'ADRIATIC.'**

Limited to 450.

Leaders.—Colonel H. CONCANON. }
 A. B. CAUTY, Esq. } Joint Managers.
 J. SANDEMAN ALLEN, Esq. (for the British
 Association).

Time Table.—The R.M.S. 'Adriatic' will be lying in the West Huskisson Dock, and the inspection will commence at 2.30 p.m.

To arrive at the West Huskisson Dock it is advisable to take the Liverpool Overhead Railway from, say, the Pier Head Station to the Canada Dock, which is the nearest point to where the vessel is lying; it is a run of only a few minutes, and there are trains every three minutes.

The White Star Line have kindly invited the Members to tea on board the 'Adriatic' about 4 o'clock.

THE White Star liner 'Adriatic,' 24,541 tons, is the largest steamer sailing regularly from the port of Liverpool, and is associated with the steamers 'Baltic,' 23,884 tons, 'Cedric,' 21,073 tons, and 'Celtic,' 21,026 tons, in maintaining a weekly service between the Mersey Port and New York, via Queenstown.

In the 'Adriatic' there is focussed the experience and scientific skill of some of the most experienced managers, designers and builders. Some of her main features may be tabulated as follows:—

Tonnage	... ..	24,541 gross.
Accommodation for	... ..	3,000 souls.
Crew (about)	... ..	500
Length over all...	... ..	726 feet
Breadth	... ..	75 feet.
Depth	... ..	56 feet.

Some idea of the progress which has been made in the building of these Atlantic liners may be gathered from a comparison with the old 'Adriatic,' which in her day was a celebrated vessel, both in respect of size and accommodation. She was built in 1872. Her accommodation for passengers and crew combined was under one thousand. Her gross tonnage was 3,887 tons, and her length was just about one-half that of the present 'Adriatic.'

The Dining Saloon is situated on the upper deck, and extends the full width of the ship, and it contains seating accommodation for about 400 people. The style of the apartment is Jacobean, and the general tone is a delicate ivory white, with charming lighting arrangements. A fine orchestra is carried, which is always an attraction, especially on board ship.

The Drawing Room, Lounge and Smoking Room are on the boat deck, and these apartments form, with the cabin accommodation and the private suites, as perfect facilities as could possibly be desired by the passenger crossing the Atlantic.

TURKISH BATHS AND GYMNASIUM.

Chief of the ship's novel features are the Turkish baths, the plunge bath, the electric bath, and adjacent to them is a plunge bath. Still on the same deck there is a perfectly equipped gymnasium in which passengers may keep themselves fit during the voyage.

STATE ROOMS AND OTHER ACCOMMODATION.

A continuous shade deck runs fore and aft, with three tiers of deck houses and three promenade decks alongside them. The 'Adriatic' has a very large number of First Class single berth rooms, this being a feature which travellers will greatly appreciate. These rooms have extra wide beds, writing tables, wardrobes and other facilities, and the decorations consist of white panelling, imparting a bright and cheerful character.

SECOND AND THIRD CLASS.

The Second Class appointments include a most comfortable dining saloon, smoking room, ladies' room and a cosy lounge, a feature of which is the oak panelling. State rooms having two, three and four berths are well lighted and ventilated, and all equipments are of the very best. There is also a good barber's shop, and ample deck space is provided for games and sports.

The Third Class quarters are excellently fitted, and here a great feature is the very large number of two, three and four berth rooms, and the very commodious and comfortable dining saloon.

It was with the advent of this famous Company in 1869 that great marine improvements began to manifest themselves. The first 'Oceanic' was laid down in that year. A diminutive craft as ships go to-day, she nevertheless embodied in her construction important departures in naval architecture, which have approached their maximum development in such floating wonders as the 'Olympic.'

The 'Oceanic' arrived in the Mersey in February, 1871, and created a sensation. Then followed others in quick succession, notable amongst which were the first 'Britannic' and the 'Germanic,' built in 1874. The earliest steam ships of the White Star Atlantic Fleet were remarkable for their uniformity of speed, reducing the passage which had previously averaged $9\frac{1}{2}$ or 10 days to about $8\frac{1}{2}$ days. In 1888, the 'Cufic' and 'Runic' were built for the live stock and cargo trade between Liverpool and New York, and these were the last of the Company's single screw vessels. This trade grew enormously, with a result that the 'Nomadic,' 'Tauric,' 'Bovic,' 'Cevic' and 'Georgic' followed in quick succession, all the foregoing being twin-screw steamers, the 'Georgic' having a tonnage of 10,077, but owing to changing conditions of trade, these vessels were later employed in other services.

Following the 'Cufic' and 'Runic,' which were experimental in their engines, came the 'Teutonic' and

the first 'Majestic' twin screw steamers, of 10,000 tons, and luxurious passenger accommodation, and for many years each of these famous liners was a favourite with trans-Atlantic passengers. These stately ships call for special mention in that they were the first British Mercantile Armed Cruisers. The inauguration of a passenger and cargo service between Liverpool, South Africa and Australia took place in 1899, when the 'Medic' sailed from the Mersey, the ships associated with her being the 'Afric' (lost in the War), 'Persic,' 'Runic' and 'Suevic,' all of 12,000 tons, and fitted for one class cabin passengers only. Later, in 1913, came the 'Ceramic,' 18,495 tons, the largest vessel in the Australian trade, and one of the most beautifully equipped and spaciouly designed.

To revert to the Company's Atlantic Services, in September, 1899, the new 'Oceanic,' re-named after the pioneer ship of the Line, was placed in commission, her gross register tonnage being 17,274. She was the first steamer to exceed the Great Eastern in length. Steamer after steamer of increasing tonnage was thereafter quickly added to the Fleet, the 'Celtic,' 21,026 tons, 'Cedric,' 21,073 tons, 'Baltic,' 23,884 tons, and 'Adriatic,' 24,541 tons, all being engaged in the Liverpool-New York trade. These fine vessels are famous as the 'Big Four,' and as is well known, the 'Adriatic' is the largest liner sailing regularly from Liverpool.

The White Star Line's service between Southampton, Cherbourg and New York was commenced in 1907, and in 1909 the White Star combined with the old Dominion Line in forming a joint service between Liverpool and Canada, known as the White Star-Dominion Line.

The 'Regina' and 'Doric' are new additions to the White Star-Dominion Line fleet, the former making her first trip on the Canadian route in March, 1922, whilst the 'Doric' made her maiden voyage only a few months ago. The Canadian Service is to Quebec and Montreal in the summer season, and Halifax, N.S., and Portland, Me., in the winter, and is operated by the popular

R.M.S. 'Megantic,' 14,878 tons, carrying First, Second and Third Class passengers, and the new s.s. 'Doric,' 16,484 tons, and 'Regina,' 16,500 tons, which, with the 'Canada,' 9,472 tons, carry Cabin and Third Class passengers only. The 'Doric' and 'Regina' call at Belfast westbound, and are the largest and fastest steamers sailing to Montreal, the most direct route for Ontario.

The most recent additions to the White Star fleet and the most notable are the 'Homeric,' 34,356 tons, and the gigantic steamer 'Majestic,' of 56,551 tons, the largest steamer in the world, which, with the famous 'Olympic,' 46,439 tons, form the 'Big Three' sailing from Southampton, whilst the triple-screw s.s. 'Pittsburgh,' which made her maiden voyage only last year, maintains, in conjunction with the 'Canopic,' a service between Southampton, Cherbourg, Halifax and New York.

No. 5.

THE UNITED ALKALI CO. LTD., WIDNES.

Limited to 250.

Leaders.—Sir MAX MUSPRATT, Bart, Chairman.

Dr. G. C. CLAYTON, M.P., Director.

R. HOLDEN DAVIDSON, Esq., Director.

Dr. J. T. CONROY, Chief Chemist.

F. W. BAIN, Esq. (for the British Association)

At the invitation of The United Alkali Co. Ltd. there will be a special train, which will leave Liverpool Central Station at 2.0 p.m., and take the party to Widnes. After the inspection of the Works, a special train will bring the party back to Liverpool.

THE importance to this country of a highly-developed Chemical Industry has long been recognised by many devoting themselves to pure and applied science, but

it is only within the last decade that the importance—aye, the necessity—of such an industry has been forcibly brought home to the general public.

The foundation of any wide and general Chemical Industry lies, of course, in the manufacture of heavy chemicals—acids, alkalies and chlorine. In such products this country has held a proud and pioneer position, and for many years supplied the major part of the world's requirements. The industry, founded in this country 100 years ago by James Muspratt, attracted many men of marked ability and attainment, and in its records we find the names of several generations of Muspratts, Tennants, Gaskells, Gambles, and Gossages, of Mond and of Brunners, Allhusens and Chances, together with the names of Deacon, Glover, Hargreaves, Hurter and Weldon attached to process or plant, recalling to mind improvements in, or noteworthy departure from, existing standards.

Changes in processes and in world competition led to the formation of the United Alkali Company, Limited, in 1890, bringing under one control nearly the whole of the manufacturers of bleaching powder and of alkali by the Leblanc process. Its present Chairman, Sir Max Muspratt, Bart., is the grandson of the James Muspratt who founded the industry, and in his guidance of the company's fortunes he continues the family record of support of pure science, of belief in the value of research, and of carrying into practice in the works the possibilities revealed in the laboratory. In great measure his aim is to assist in the development of a full and complete chemical industry at home and to make certain that this industry on which most others depend receives the recognition so long withheld.

The works of the United Alkali Company in Great Britain cover an area of over 1,000 acres (Bristol, Fleetwood, Glasgow, London, Newcastle, Runcorn, St. Helens, Widnes). The manufacture of the older products is maintained, and much fresh ground has been explored.

Soda ash (alkali) is no longer manufactured by the

Leblanc process but by the more direct ammonia soda process, whilst chlorine, formerly produced from hydrochloric acid by oxidation with pyrolusite (natural MnO_2), later with recovered manganese (Weldon process), and in the last years by air, with copper salt as catalyst (Deacon process), is now obtained directly by electrolysis of brine with its equivalent of caustic soda solution.

Certain of the new processes are installed at the Pilkington-Sullivan Works, Widnes, and opportunity to visit these is afforded to members of the British Association during its meeting at Liverpool this year.

These Works occupy 43 acres, and—like others in Widnes—have direct rail communication with two of the new large railway groupings, and *via* canal with the Port of Liverpool. To these advantages are added proximity to the Lancashire coal-field, the Lancashire and Cheshire salt mines, and the limestone quarries of Derbyshire. The raw materials for the alkali and bleach are close at hand, and practically the only important raw material coming from a distance is sulphur for vitriol manufacture either as native sulphur or as pyrites from the company's Spanish mines.

The Pilkington-Sullivan Works produce sulphuric acid for internal consumption by the chamber process, with hand-burners for lump stone and mechanical-burners for 'smalls.' Nitrous gases are supplied by ammonia oxidation, and chambers are fitted with water-sprays. It possesses a large superphosphate plant and a considerable installation for the manufacture of its nitric acid requirements. The general lay-out of the Works and the interest of the moment render it desirable to confine the present visit to the latest methods of brine electrolysis for the production of caustic soda and chlorine, of bleaching powder manufacture, and the preparation of organic intermediates for dyes and explosives, in which chlorine has a part.

The electrolytic plant, operated on the diaphragm

system of ionic separation, presents the most successful cell in operation to-day. The cell has its competitors, many of which may show the same current efficiency with equal alkali content of cathode liquor, but in a comparative sense the Gibbs cell shows unequalled energy efficiency, which, after all, presents a big factor in the cost of product, coupled with comparatively low repair costs due to excellence of design. It is a case in which the chemical engineer may justifiably claim much credit. The itinerary will show the preliminary purification of the brine, the cell-room with its substation, the vacuum multiple effect evaporation of the cell liquor and the utilisation of the chlorine.

In elaboration it is desirable to add that the substation receives alternating current from the company's generating plant at West Bank, and transforms and converts this to direct current according to plant requirements. This power is supplemented by steam-generated power produced at the Works in quantity corresponding to the prevailing demand for low pressure steam.

In connection with chlorine utilisation, it may be added that until recently the main outlet for chlorine was in the production of bleaching powder. Such utilisation will be shown in various types of plant, and will include, in addition to the Weldon chamber, the most successful continental plant for complete absorption together with the latest mechanical plant developed in this country. To-day there is a growing tendency towards the use of liquid chlorine for water sterilisation in the milling industry and in the paper and textile industries, and the United Alkali Company is prepared—and possesses the necessary plant—to meet any of these developments. As a matter of fact, the company has proved for itself the value of liquid chlorine in several instances and anticipates others, and foresees early recognition of the value of a product of practically 100% purity.

Chlorine has further uses in Organic Chemistry, from whence are obtainable benzyl and benzal chlorides,

useful in themselves, and also leading to benzyl alcohol, benzaldehyde and benzoic acid. The company has processes and plant for the manufacture of these and other chlorinated products. The major outlet, however, in the Pilkington-Sullivan Works lies in the chlorination of benzol, and the plant for the manufacture of chlor-benzenes and their derivatives will be shown. In sequence we have the chlorination house followed by the distilling for the separation of the pure mono- and di-chlor-benzols, the nitration to mono- and di-nitro derivatives of the mono- and di-chlorinated products and the hydrolysis of the previously isolated chlor-nitro derivatives. The variety of intermediates so obtainable, together with their very important reduction products, is well demonstrated in the Scientific Exhibition arranged in connection with this year's meeting. The size of the plant and its possible output may help to bring home to those who see it the importance of the Dye Industry as an industry, the outlet the Dye Industry provides for the development of the heavy chemical trade, and, not least, the efforts that have been made by the United Alkali Company to play its part in making the Chemical Industry of this country fit to cope with the many and complex demands of the present day.

No. 6. Section A.**AUTOMATIC TELEPHONE MANUFACTURING
CO. LTD.,
MILTON ROAD, EDGE LANE, LIVERPOOL.**

Limited to 20.

Leader.—J. RICE, Esq., M.A.

Time Table.—The party will assemble at St. George's Hall at 2.30, and will travel to and from the Works by special tramcars.

INAUGURATED at the end of 1911 for the purpose of manufacturing and installing Strowger Automatic Telephone Equipment in Great Britain, her Colonies, and certain other territories abroad, this Company took over the existing Instrument Works at Milton Road, Edge Lane, Liverpool, of Messrs. British Insulated and Helsby Cables, Limited.

During the past 12 years, both buildings and plant have been very considerably extended, and the Company boasts an establishment capable of turning out Automatic Telephone Equipment equal to 50,000 lines per annum or over.

The total area covered by the Works is 46,000 square yards, and including a highly skilled technical staff, some 1,500 persons of both sexes are employed.

The buildings comprise two main sub-divisions, viz., a multi-storey block of from two to five storeys, and a ground floor, north-light block.

The higher five-storey building is utilised for Stores and Apparatus Inspection; the heavier raw material being housed on the ground floor, whilst the upper storeys accommodate the lighter parts and finished apparatus. There is a convenient lift service to all floors.

The ground floor, including the radiating wings, provides accommodation for a thoroughly equipped and

modern Tool Room, an extensive Plating and Finishing Department, and a Framework and Construction Shop respectively.

The upper floors are utilised as Apparatus Assembly Departments.

A comprehensive Machine Department, fully equipped with modern plant, including a Battery of Automatic Machines, Presses, Drilling and Milling Machines, Capstan Lathes, etc., occupies one-half of the ground floor north-light block.

Ample Canteen accommodation is available, together with Staff Dining Rooms.

At the time of its formation, the Company acquired all the Patents and certain territorial trading rights in Strowger Automatic Telephone Equipment from Automatic Electric Co., of Chicago, who had previously been manufacturing Strowger Automatic Telephone Equipment for use in the States and elsewhere for upwards of twenty years.

In the brief period immediately preceding the War, contracts were secured by the Company for the equipment of certain British Post Office Exchanges; the first being a comparatively small installation of some 500 lines at Epsom, together with a trial installation at the G.P.O., (West) London, for the use of the Post Office staff.

These initial contracts were quickly followed by others for the conversion of British Post Office Exchanges in certain provincial towns and cities, the largest being Leeds, with a present equipment of 10,000 lines. Other British Post Office Strowger Automatic Exchanges with their equipments to date are as follows:—

Accrington	...	...	...	...	1,100 lines.
Blackburn	...	...	...	...	2,400 lines.
Chepstow	...	...	...	...	100 lines.
Newport	...	...	...	...	1,800 lines.
Paisley	...	...	...	...	1,600 lines.
Portsmouth	...	...	...	...	5,200 lines.

Due to the War, further developments of the Strowger Automatic Telephone System in this country were considerably retarded, and it is only within the last year or two that progress has been made in the shape of extensions to existing Automatic Exchanges. An extensive programme is under consideration however, and it is probable that the next few years will see a rapid increase in the growth of Strowger Automatic Telephones throughout the system owned and controlled by the British Post Office.

Foreign and Colonial Telephone Administrations have made rapid strides in the adoption of this up-to-date Telephone System.

The India Office was one of the earliest to appreciate the benefits of Strowger Automatics, and a small trial installation at Simla in 1914 was rapidly followed by successive extensions until the present equipment totals some 2,100 lines.

Other Strowger equipments installed by the Indian Government are:—

Amritsar	...	...	...	...	400 lines.
Lahore	...	...	...	...	1,700 lines.

The development of Strowger Automatic Telephony in India has not been confined to the system owned and worked by the Government.

Following on the success of the Government Installations, the Bombay Telephone Co. have recently placed a contract with the Company for the equipment of two exchanges in that city, Central and Gell Street respectively, the total capacity of which is some 11,000 lines.

Manchuria also quickly appreciated the advantages of the Strowger system, and a 3,000 line Strowger Automatic Exchange at Harbin, the Great Railway centre, has since been followed by a 5,000 line equipment installed at Dairen by the Kwantung Government. Both these installations are now in full and satisfactory operation.

In Mesopotamia Strowger Automatics have been installed by the Company at Ashar, Basra, Magil and Makinah, to the total of approximately 1,000 lines.

In the Argentine, another progressive country, the United River Plate Telephone Company were among the first to appreciate the claims of the Strowger System, and contracts were secured at the outset of the Company's career, for the equipment of initial Exchanges at Cordoba and Rosario respectively. There are now similar installations at Alta Cordoba, San Vincente, and, more latterly, Buenos Aires, the scheme for this city embracing no less than 7,500 lines initial equipment, with facilities for ultimate extension to upwards of a million lines.

The whole of the equipment involved in these several installations was manufactured by the Company at its Liverpool works.

In addition to the manufacture and installation of Public Telephone Exchange equipment on the Strowger Automatic System, Automatic Telephone Manufacturing Company also cater for the requirements of private users, and manufacture a series of Strowger inter-communication equipments familiarly known as P.A.X. (Private Automatic Exchanges), ranging from 10 lines capacity upwards. These equipments are miniature replicas of the more extensive installations and embody identical apparatus. They are particularly applicable to the internal telephone requirements of Mills, Factories, Business Offices, Institutions, etc., where they ensure a speedy, accurate and reliable telephone service, without the expense and shortcomings of the human operator.

In addition, the Strowger P.A.X. will furnish, if necessary, such auxiliary services as Conference Feature, Code Call, Fire Alarm, Watchman's Supervision, Secretary Service, Directors' Priority, and other special features peculiar to Private Telephone Inter-communication as distinct from the public service. They can also be linked up, if necessary, with the

Public System, affording full inter-communication with the Post Office Service.

Among those products calling for special mention are modern Telegraph Apparatus, which the Company not only manufactures to standard British Post Office designs, but has also evolved a comprehensive series of special designs incorporating novel features, which appeal very strongly to all Telegraph Engineers throughout the world, and already enjoy a considerable market both at home and abroad. Noteworthy examples are the A.T.M. Undulator, A.T.M. Wheatstone, Gulstad and High Speed Relays, Single Unit Artificial Line, etc.

Another Department deals with Mine Signalling Appliances, Mining Telephones and the smaller Signalling Accessories required by Mines and Collieries; outstanding products being the A.T.M. Visual Winding Signal Indicator for use in Colliery Engine Rooms under General Regulation 95 of the Coal Mines Act; the A.T.M. Magneto Mining Telephone, a very popular and robust model of which some thousands are already in use, and the A.T.M. Flameproof and Weatherproof Bells, for use below and above ground respectively.

Railway Signalling Apparatus is also manufactured by the Company, the A.T.M. Transient Track System, D.C. and A.C. Relays, and other associated apparatus being of exceptional merit.

In Electric Heating and Cooking Appliances, Automatic Telephone Manufacturing Company has established a considerable reputation both in the home and foreign markets, the well-known 'XCEL' Irons, Cookers, Fires, Kettles, etc., being exceptionally high grade products.

Latterly, the Company has devoted its attention to the production of Wireless Receiving Apparatus for Broadcasting, and has also manufactured an extensive range of Receiving Sets and components, among which special attention may be directed to the A.T.M. Crystal Detector Set, A.T.M. Long Range Radio Headphones,

and more particularly the 'Claritone' Loud Speaker, which in both large and small models is generally accepted as the loudest, clearest and most efficient apparatus of its kind at present on the market.

No. 7. Section B.

See Excursion No. 5.

THE UNITED ALKALI CO. LTD.

It has been arranged that Members of Section B will visit these Works at the same time, but they will be formed into a separate party and will be taken round parts of the Works that are of more particular interest to Chemists.

No. 8. Section B.

HIGHFIELD TANNING CO. LTD., RUNCORN.

Leader.—Dr. McGOOKIN.

Price 3/10 return.

Time Table.—The party will meet at the booking-office in Lime Street Station at 2 p.m. Train leaves Lime Street Station 2.10 p.m., arriving Runcorn 2.43 p.m., returning 5.30 p.m.

The itinerary of the visit is as follows:—
1. Visit to Hide Store, where hides are sorted into their different classes. 2. Visit to Lime House, where hides are prepared for unhairing and fleshing, the process being explained by which the hair and flesh are taken from the hide, and the hide left clean ready for going into the tanning process; the assortment of hides for their different purposes. 3. Visit to Tan Yard, where the processes of tanning take place, showing penetrations of vegetable tans at

different stages. 4. Visit to the Splitting Shop, where motor and other hides for the upholstering trade are split to their varying substances. 5. Visit to the Finishing Sheds, where sole and other classes of leather are dried and prepared for the market. 6. Visit to the Warehouses, where the leather will be shown ready for distribution, and various samples of leather which have suffered from pest and disease will be inspected, especially as regards the ravages of the warble and tsetse flies.

No. 9. Section C.

HALL ROAD AND CROSBY SHORE, &c.

Limited to 50.

Leaders.—J. H. MILTON, Esq.
C. B. TRAVIS, Esq.

Cost 1/6.

LEAVE Exchange Station (Tithebarn Street, Liverpool) by 2.30 p.m. electric train for Hall Road (3rd class single fare, 9d.), walk to the shore, noting recent accumulation of blown sand, and proceed southwards to see effects of recent erosion of the sand dunes (with destruction of houses and gardens) due to tidal action in conjunction with fluctuations in the channel of the River Alt.

Then proceed northwards along the shore to examine the section of post-glacial deposits, consisting of the 'superior peat and forest bed' lying upon grey sands and silts ('Formby and Leasowe Marine beds') and overlain by the sand dunes, which contain recent peaty bands. Stumps of trees and prostrate trunks embedded in the peat occur, but these are undergoing very rapid destruction by wave action.

Return from the northern point across the Golf

Links, and proceed to an old quarry in Keuper Sandstone at Little Crosby, on the edge of which a glaciated and striated surface of sandstone is exposed. Continue the walk through Little Crosby village, passing the ancient stone cross with glacially striated slabs built into its base, to Great Crosby, where, within a railed enclosure, is placed (in its original orientation) a great boulder of gypsum, estimated to weigh 18 tons, found in an adjacent brickpit.

From this point the return journey will be made by tram-car, connecting with the Liverpool Overhead Railway running alongside the docks, to the Pier Head Station; or alternatively, and somewhat more quickly, from Waterloo Station (alighting from the tram-car at South Road) to Exchange Station; Liverpool being reached in each case between 6.30 and 7.0 p.m.

No. 10. Sections E. & F.

LIVERPOOL DOCKS.

Limited to 100.

Leader.—C. CONCANON, Esq., Outdoor Asst. General Manager, Mersey Docks and Harbour Board.

Time Table.—The party will assemble on St. George's Hall Plateau at 2.30, where special motor buses will be waiting.

2.45—3.15, visit Tobacco or Wool Warehouse, Stanley Dock.

3.30—4.45, visit Huskisson and Canada Docks, which deal with North Atlantic traffic.

5.0, tea will be provided, by kind invitation of the Mersey Docks and Harbour Board, at their Head Office.

The actual vessels and berths seen at the North Docks will, of course, depend on the vessels which happen to be in port on the date of the excursion.

For further details reference should be made to the handbook "Merseyside."

THE STANLEY DOCK TOBACCO WAREHOUSE.

Among the warehouse accommodation, for which the Port of Liverpool has long been famous, figures the Stanley Dock Tobacco Warehouse with its thirteen floors (containing 36 acres) and accommodation for 70,000 hogsheads. This is the largest warehouse in the world, and some idea of its size may be obtained when it is stated that it is 725 feet long, 165 feet broad, and about 125 feet high from the street level, has a basement, quay floor and twelve upper floors, and required 27 million bricks and 6,000 tons of iron in its construction. The whole of the accommodation at this warehouse is, of course, 'bonded.'

THE COLONIAL AND EAST INDIA WOOL
WAREHOUSES.

Another unique warehouse has been provided by the Mersey Docks and Harbour Board at Liverpool, though not on a dock quay, for the storage, working and showing of Colonial Wool, in which 40,000 bales can be accommodated after allowing for 'showing' facilities, or 86,000 if only 'dead' storage is required. Ample natural lighting facilities are found in this warehouse, together with the most up-to-date electric appliances, cranes, piling machines and trucks, while 15,000 bales can be placed in 'show' piles for public auction without restricting the gangways from which the buyers inspect the wool to be sold.

The East India Wool Warehouse in Great Howard Street is capable of storing 90,000 bales after allowing for 'showing' facilities, or 150,000 bales if stored in block piles.

FRIDAY, SEPTEMBER 14TH.

No. 11.

CAMMELL LAIRD & CO. LTD.

Leaders.—R. S. JOHNSON, Esq., Managing Director.
J. W. P. LAIRD, Esq., J.P., Secretary.
W. RIMMER TEARE, Esq. (for the British Association).

The party will leave the Liverpool Landing Stage by the 2.30 Birkenhead (Woodside) boat, and special motor 'buses will take them to and from the Works.

THIS firm, with its headquarters in Sheffield, has extensive works in that city, as well as in Birkenhead, Nottingham and Birmingham. At Sheffield heavy steel forgings and armour plate are made, while the Nottingham and Birmingham works produce railway plant of varied description.

The yards at Birkenhead are devoted to shipbuilding and repairing, to engineering and boiler-making, and were founded as far back as 1824, when Mr. John Laird established the business of building iron ships—an industry then in its infancy.

For this class of work, Birkenhead gained a world-wide reputation, and the paddle steamers 'Lady Lansdown,' supplied to Ireland, and the 'John Randolph,' sent to America, were famous in their day.

One of the first screw-propelled vessels afloat, the 'Robert F. Stockton,' was launched at Birkenhead in 1839.

THE BIRKENHEAD WORKS.

From a few acres in 1824, the Works have steadily grown, till to-day they cover an area of 108 acres.

There are twelve building berths, six in the North Yard capable of taking vessels up to 375 feet in length,

and six in the South Yard whose capacity ranges from 700 to 1,000 feet. The Company are thus able to construct the largest of warships and ocean-going liners. The part of the River Mersey into which these berths launch is three-quarters of a mile in width, and there is ample depth of water to float the largest and heaviest of vessels.

Of equal importance to the new construction facilities is the provision on a large scale for the repairing and reconditioning of all types of vessels. This class of work forms a very important feature of the Company's activities, and enabled it during the War to overhaul, refit or repair as many as 502 vessels, representing over 2,000,000 tons of shipping and 4,000,000 horse-power of marine engines.

There are, in all, seven graving docks, two of which are 708 and 861 feet long respectively. Between the two large docks runs a 40-ton electric crane, capable of plumbing the centres of both.

In addition, a large wet basin is provided for the fitting out of new vessels and the treatment of damaged vessels which can be repaired afloat. It has an area of 14 acres and the width of the river entrance is 140 feet. The hoisting gear installed includes a fixed crane of 150 tons and a floating crane with a lifting capacity of 200 tons.

There are carefully-designed and fully-equipped sheds and shops for the preparation of material. The engine shops and boiler shops are alongside the fitting-out basin, and thus afford splendid facilities for the completion of vessels within the Works. They contain plant of the most modern description for the manufacture of propelling machinery of the highest class, including geared turbine machinery and internal combustion engines, and there are enormous resources for the manufacture of marine boilers, both cylindrical and water-tube. Boilers and turbines are built not only to supply the needs of the Company's shipyard but also in considerable numbers for firms at home and abroad.

Now that Messrs. Cammell Laird and Co. have

improved and perfected the 'Camellaird-Fullagar' oil engine, the construction of these engines has become an important branch of the engineering side of the Company.

Included amongst the other shops are the saw mill and joiners' shop, which enable the firm to do the whole of the woodwork in connection with the fitting-out of the vessels they build. The saw mill is provided with extensive sheds for the storing of timber.

The hydraulic, pneumatic and electric machinery and tool installations are up to date in every respect. The entire power for the shipyard and engine works is provided by two turbine power stations, with turbo-alternators giving a capacity of 6,000 kilowatts.

A number of ships are at present building or undergoing repairs.

No. 12.

CUNARD STEAM SHIP CO., LTD., R.M.S. 'FRANCONIA.'

Limited to 450.

Leaders.—JAMES AMBROSE, Esq. (Cunard Passenger Superintendent).

J. SANDEMAN ALLEN, Esq. (for the British Association).

Time Table.—The R.M.S. 'Franconia' will be lying in the Huskisson Dock, and the inspection will commence at 2.30 p.m.

To arrive at the Huskisson Dock it is advisable to take the Liverpool Overhead Railway from, say, the Pier Head Station direct to the Huskisson Dock; it is a run of only a few minutes, and there are trains every three minutes.

The Cunard Steam Ship Co., Ltd., has kindly invited the Members to tea on board the 'Franconia' at 3.45.

REGULAR steam navigation between England and America was established in 1840, when the first

Cunarder, the small wooden paddle steamer 'Britannia' crossed the Atlantic in 14 days 8 hours, at an average speed of $8\frac{1}{2}$ knots. Between then and 1923 the Cunard Company has been closely associated with every development in ocean travel until to-day. their latest super-liner 'Franconia' is practically a new type of passenger liner, and the claim that no other ship meets so completely the needs of the modern traveller is likely to be borne out by an inspection of her wonders. She has been constructed, not only for service in the North Atlantic, but also to undertake lengthy cruises in the Seven Seas. Indeed she is the first ship of her class ever constructed specially for this latter purpose. For modern liners it is difficult to find a single phrase that describes them. They have been called 'floating hotels' and 'floating palaces,' but it is felt that in the case of the 'Franconia' such phrases are entirely inadequate.

She is a liner of innovations, and probably the most outstanding is her great Sports Arena, which comprises a large swimming bath, a squash racquets court with a gallery for spectators, and a gymnasium. It occupies 5,000 square feet and extends upwards through two decks. The gymnasium is one of the most up to date afloat, while the swimming bath is among the largest to be found aboard ship. A bas relief of Myron's Discobulus is prominently placed in the entrance to the arena, while the bas relief decorative frieze of the swimming bath is taken from authentic Greek vases from the tomb of Alexander and from the Parthenon metopes.

Difficult as it is to single out for particular notice any special portion of her wonderful passenger accommodation, the superb nature of her staterooms call for admiration. In reality they are bedrooms fitted with mahogany bedsteads, large wardrobes, dressing tables, night tables, bookcases, easy chairs and settees. Hot and cold running water arrangements are to be found in all first class staterooms, and a special system of ventilation has been introduced. There are

no fewer than seventy private suites with private baths and many with sitting rooms. There are also eighty staterooms fitted with special berths for children. There is, in addition, a valet service.

The 'Franconia's' public rooms are of exceptionally generous proportions, and have been carried out on extremely handsome lines. The first class writing room is decorated in a rich blue and gold scheme, with 'Princess Blue' scagliola columns. Here will be found reproductions of the beautiful lyre-back chairs by Robert Adam.

The influence of the art of the period of William of Orange will be found in the magnificent lounge, with its black and gold walnut furniture, and rich velvets and tapestries. There are painted panels after Snyders, the celebrated Dutch exponent of still life.

The smoking room is typical of an old English inn, oak panelled, half timbered, and arranged with a striking brick ingle-nook. Here will also be found original antique Elizabethan engravings of Queen Elizabeth, Sir Francis Drake, Sir Walter Raleigh and Sir Thomas Smith.

There is seating accommodation for 350 diners in the handsome dining saloon. The period of decoration is that of the Louis Seize style. A delightful system of lighting has been adopted, which depends entirely upon the reflected light from the oxidized-silver table lamps.

The special cardroom adjoining the handsome writing room, resembles a Georgian room of a well-known club in the West end of London, while the floors of both garden lounges have been specially prepared for dancing.

The second class dining saloon has been treated in the vigorous early Georgian style with a musicians' gallery introduced in the dome. As in first class, passengers in the second class have the use of small dining tables. Delicately-carved late eighteenth century furniture predominates in the second class lounge.

Second class passengers have the sole use of the verandah cafe, and there is also a smoking room designed on the same lines as that in the first class.

An extraordinary amount of space has been devoted to third class passengers. There are two large dining saloons, a smoking room and a general room. All these public rooms are decorated in simple oak panelling with white friezes. There are special cabins to accommodate families, and throughout there are hygienic hair mattresses and complete toilet arrangements.

But the 'Franconia' is not the only vessel of the Cunard fleet which expresses the latest in the art of scientific shipbuilding. It is to be found also in the new ships 'Scythia,' 'Laconia' and 'Samaria,' engaged in the Atlantic service, and the cabin and third class steamers, 'Andania,' 'Antonia' and 'Ausonia,' known as 'two class ships,' which operate the Company's Canadian service between London, Southampton, Cherbourg, Quebec and Montreal. Being divided into two sections instead of three, these Canadian steamers offer unusually varied and extensive accommodation in each class, and provide the maximum of comfort at a moderate cost. Interior decorations have been carried out upon the same magnificent lines that have made all Cunard ships famous as models of luxury and taste. Their public rooms include dining saloons, lounges, writing room, smoking room and a verandah cafe. Parents travelling with children will appreciate the convenience provided by the special children's room, which is a feature of each of these steamers. All the staterooms are supplied with running water, the berths are wide and long, the toilet and bathing facilities are complete in every detail, and the furnishing invites the passenger to a comfortable, restful night's repose. Throughout these vessels will be seen the hand of the scientific expert, and the many features introduced cannot fail to satisfy the ceaseless demand for something new.

No. 13.**JOHNSON BROTHERS (DYERS) LTD.,
BOOTLE DYE WORKS.**

Limited to 200.

Leaders.—Sir BENJAMIN JOHNSON, D.L., High Sheriff of the County Palatine of Lancaster.

A. E. SHENNAN, Esq. (for the British Association).

Time Table.—Messrs. Johnson Brothers (Dyers) Ltd. are kindly providing motor vehicles to carry the party to and from the Works.

The party will assemble on the Plateau of St. George's Hall at 2 p.m., and will return at 5.15 p.m.

During the visit Messrs. Johnson Brothers (Dyers) Ltd. will kindly provide tea at 4 p.m.

It will not be possible to give more than the barest outline of the activities of this firm in the space available. It will be well, perhaps, before enumerating the departments and processes, which it is hoped to show to the members of the British Association on their visit, to give a brief outline of the history of the firm:—

The firm of Johnson Brothers (Dyers) Limited was established in Liverpool over 100 years ago. In 1889 the total number of employees was 32. The number of employees at the Works now is nearly 1,200, and there are a further 900 at the 375 branches which feed the Works, making a total of about 2,100. Success has been attained in preserving personal relationships between employers and employees, and any prosperity which may have been achieved has been shared. A Works Profit Sharing Scheme has been in existence since 1911.

There is an active Welfare Department. Meals are provided at cost price.

There are nearly 100 employees with over 20 years'

service to their credit. Medical and dental facilities are afforded for employees; there being also Sick Societies with benefits guaranteed by the firm.

The Recreation Grounds, close to the Works, are provided with Bowling Green, Tennis Courts, allotments, football ground, clubhouse with billiard room for the men, and a large building for entertainments and lectures. There is a convalescent and rest house at Hoylake. It is hoped that the conditions under which work is done, the general appearance of the workers, the atmosphere—physical and mental—of the workers generally will afford the members of the British Association a substantial proof of the happy conditions obtaining at Bootle.

A Works Journal records the many and varied activities—business, personal, athletic and social—of the 2,100 people who, at Bootle and in the 375 branches, make up the organisation of Johnson Brothers (Dyers) Ltd.

The actual visit to the Works will begin at 2 p.m. Departments will be visited in the following order:—

CHECKING ROOM, where the millions of garments and other articles received from the branches are checked and sorted.

HATS, where hats are cleaned and re-modelled to fashionable shapes.

DRY CLEANING HOUSE. Everything which is received is passed through here, all trace of dirt and grease being removed by spirit or the dry cleaning process, usually known as French Cleaning.

HAT AND FEATHER DYEING.

DYE HOUSE, where the main dyeing operations are carried out.

HEAVY WORK DEPARTMENT, where all household furnishings are dealt with, chintz glazed, blankets finished, etc.

PACKING ROOM, where the final stage of packing and despatching goods to customers, through the branches, is carried out.

CURTAIN ROOM, where all curtains are cleaned and repaired.

IRONING ROOM, PLEATING AND FOLDING ROOM, UPHOLSTERING DEPARTMENT, DRESSMAKING DEPARTMENT, FEATHER AND FUR FINISHING, INVISIBLE AND ORDINARY DARNING.

The break for tea will take place about 4 o'clock, when tea will be provided in the Girls' Dining Room.

Whilst it is recognised that a number of these processes will have, perhaps, a special appeal to the lady members of the Association, it is probable that the male members will also be interested in them.

The visit will conclude at 5-15, when motor vehicles will convey the visitors back to their Liverpool Headquarters.

No. 14.

LISTER DRIVE POWER STATION, LIVERPOOL CORPORATION.

Leader.—H. DICKINSON, Esq., M.Inst.C.E., M.I.M.E.,
M.I.E.E., City Electrical Engineer.
(for the British Association).

The party will assemble at St. George's Hall at 2.30 p.m., and will be taken out to the Power Station by motor 'bus, and after the inspection will return to St. George's Hall by motor 'bus about 4.30 p.m.

In the Handbook, 'Merseyside,' there is an article by Mr. H. Dickinson, the City Electrical Engineer, on the electrical undertakings of the Liverpool Corporation. Members are referred to that for a description of the Lister Drive Power Station. A small pamphlet, however, describing the electrical and tramways undertakings of the Liverpool Corporation will be given to each Member during the visit.

No. 15. Section B.**PRICE'S PATENT CANDLE CO. LTD.,
BROMBOROUGH POOL, near BIRKENHEAD.**

Leader.—W. DORAN, Esq., M.Sc.

Price, 1/1 return.

Time Table.—The party will meet at the Booking Office, Central (Low Level) Station, Liverpool, at 1.50 p.m. Train leaves Central (Low Level) Station, Liverpool, at 2 p.m. for Rock Ferry. Motor 'buses will meet the party at Rock Ferry and drive to the Works.

THE following is an outline of the scope of the Works: Candle-making and packing; wick-making; taper-making; paraffin refining; stearine-making; oleine manufacture; process for recovery of crude glycerin.

No. 16. Sections C and E.**STORETON, BURTON POINT AND
NORTH WIRRAL.**

Limited to 30 Members from each Section.

Leaders.—Professor P. G. H. BOSWELL.

W. HEWITT, Esq.

Professor P. M. ROXBY.

Cost 2/6.

Cross to Birkenhead (Woodside) by boat, leaving Landing Stage at 2.20. Leave Woodside by special motor cars at 2.30 for Storeton Quarries; visit the main (south) quarry in the lower Keuper Sandstone, from which large quantities of building stone and sand have been obtained. Note the system of faulting, including the north and south boundary faults, which have let down the block of Keuper constituting the axis of the ridge between the soft Upper Bunter

Sandstone which forms the lower slopes of the hill and the country on either side. Also the position of the 'footprint bed,' from which footprints of *Cheirotherium* and *Rhyncosaurus* are obtained.

Then drive across the peninsula to Parkgate and Neston, on the shore of the Dee estuary. Walk southward on the shore (from the point where the shafts of the pits working the small Wirral coalfield are situated), at the edge of the salt marshes—which have formed here since the reclaimed land situated higher up the estuary was enclosed—to Burton Point.

[The Geographical Section will leave the Geological Section at Burton Point Station for a drive through North Wirral as set out in later paragraphs.]

At Burton Point there is a good section of the lower Pebble beds of the Bunter, resting upon the Lower Soft Sandstone. The section forms the landward side of an old quarry where the hard pebbly sandstone has been extensively quarried for the construction of a 'cop' or embankment across the marshes and other purposes.

Joining the motor car in Burton village, proceed to Willaston, where an excavation in glacial sands and gravels will be visited; from thence to Woodside Ferry, which should be reached about 6.30 p.m.

GEOGRAPHICAL SECTION.

Leaving the other party at Burton Point Station, where the motor car will be rejoined, proceed through Burton (a picturesque old Cheshire village) to the main Chester highroad, running along the sandstone ridge through Heswall (with fine views of the lower Dee estuary and the Welsh hills) to Thurstaston Common, where the isolated mass of sandstone, known as 'Thor's Stone,' will be visited.

The drive will be continued through West Kirby and Hoylake, in view of the extensive sand banks, Hilbre Island, the sand dunes near the west end of the Wallasey Embankment, the rapidly wasting submerged forest bed at Leasowe; and across the low lying fenland

area which lies between the northern shore and the somewhat abrupt termination of the elevated sandstone area of the interior, past the end of Bidston Hill (with its Observatory) to Woodside Ferry, arriving there about 6.30 p.m.

No. 17. Section H.

CHESTER (Roman).

Limited to 30.

Leader.—Professor R. NEWSTEAD, M.Sc., F.R.S.

Time Table.—Those going on this excursion will leave Central (Low Level) Station by the 2-10 train, changing at Rock Ferry.

Cost 4/2.

On arrival at Chester the party is asked to gather under the clock outside the Railway Station at 3 p.m. (where they will be met by the Leader), and they will then proceed to inspect the Roman remains in situ, walls, etc., also the Roman remains in the Museum.

Excursion No. 18.

WILLIAM PROCTER, Esq., has kindly consented to conduct the Party, and will meet them at Liverpool Lime Street Station Booking Office, at 7.50 a.m., for the Special Train leaving 8.5 a.m.

SATURDAY, SEPTEMBER 15TH.

No. 18.

THE ALUMINIUM CORPORATION LTD., DOLGARROG AND SNOWDON DISTRICT.

Limited to 100.

Leaders.—HENRY J. JACK, Managing Director.

G. K. PATON, M.I.E.E., Electrical Engineer.

The party will leave by special train from Liverpool to Llandudno Junction, and from there motor coaches will take them to the Aluminium Works at Dolgarrog, in the Conway Valley, after which the drive will continue to Bettws-y-Coed, where lunch will be taken. After lunch the drive will be continued *via* Capel Curig, Snowdon, Pass of Llanberis, Ogwen, Bethesda, Bangor, Penmaenmawr, Conway to Llandudno Junction, returning thence by rail direct to Liverpool.

NOTE.—The Cwm Dyli Power Station of the North Wales Power Co., Ltd., can be seen in the valley below when passing between Pen-y-Gwryd Hotel and the Pen-y-pass Hotel (left-hand side).

Cost, 24/-.

Tickets for this excursion to be obtained from Messrs. Thos. Cook & Son, in the Reception Room.

1. These Works are situated in the Conway Valley on the Carnarvonshire side of the River Conway, about seven miles from Conway.

2. The Works were started in 1907, and have been in operation since 1909, producing Aluminium in its

various forms, such as ingot, notch bar, sheet, circles, powder, foil, etc.

3. In the earlier days, when the Works were started, the reduction of Alumina, or oxide of Aluminium, Al_2O_3 , to metal by means of D.C. current in furnaces of the Heroult type, was the only process adopted, and since then the Works have gradually extended until at the present day they are self-contained to produce and work the metal in all its stages.

4. The Works comprise:—

Power-house of 5,500 k.w. capacity.

Carbon Factory, producing Electrodes for the furnaces.

Reduction Works.

Recast Department, with electric furnaces of resistance Type.

Rolling Mill.

Powder Factory.

Foil Works,

and, in addition, the various works departments, such as fitters' shop, smithy, joiners' shop, stores, transport, despatch, etc.

5. The Hydro-Electric development at Dolgarrog is on the north-eastern slopes of Carnedd Llewelyn, including Lakes Eigiau, Cowlyd and Dulyn, at altitudes varying from 1,000 feet to 3,480 feet.

In 1907 a dam was built at Eigiau capable of impounding 160 million cubic feet of water. Later a tunnel was driven from Eigiau to the Dulyn River in order to obtain the waters of the Dulyn area and bring them into the Eigiau Storage. The surplus water of Llyn Cowlyd was also made use of, so that a total drainage area of over 10 square miles is controlled, and by means of an open leet brought to the Forebay and Penstock above Dolgarrog Works, where a net head of 1,006 feet is obtained.

The rainfall in the area varies between 70 and 100 inches per annum.

6. The Power Plant originally installed consisted of four 1,600 h.p. Pelton Wheels of Ganz design, coupled to Bruce Peebles Direct Current Generators, two 500 k.w. sets in parallel.

These machines are still in service doing good work, and have been very satisfactory in operation. Each set operates at 4,000 amperes at 125 volts or 8,000 amperes in parallel, and are direct coupled to a series of Reduction Furnaces. As the load is practically continuous, the original Hydraulic Governors with deflecting nozzles have been retained, and are quite satisfactory for this class of work.

The Pelton Wheels have been refitted with buckets of modern design and give a much higher efficiency.

7. In addition to these Generators there are installed two Motor Generator Sets, each of 600 k.w. output on the D.C. side, with a 1,000 b.h.p. Induction Motor at 1,050 volts, taking its supply from the power system of the North Wales Power Company, a connecting line at 20,000 volts, 50 periods, 3 phase, being built in 1907 for that purpose.

8. In 1918 the Aluminium Corporation obtained a controlling interest in the North Wales Power Company, and by the amalgamation of the only high pressure Hydro Electric Stations in England or Wales the Corporation acquired the means of developing the Hydro Electric resources in North Wales to the public advantage, as set out in the scheme submitted to the Electricity Commissioners for supply in the North Wales and South Cheshire Electricity District.

9. Another notable feature was the arrangement come to between the Corporation and the Cowlyd Water Board, who owned the water rights of Llyn Cowlyd and supply for domestic purposes in Conway and Colwyn Bay.

By this amicable agreement the Corporation have built the Cowlyd Dam, which will impound an additional 370 million cubic feet of water above the level of the Corporation's outlet for power purposes. Thus the Cowlyd Water Board have this increased

storage to draw upon, while, at the same time reserving for their exclusive use more than their original storage. The dam was built by the Corporation at their own expense at a cost of nearly £200,000.

10. The level of Llyn Cowlyd is now increased from 1,170 feet to 1,207 feet above sea level.

11. On the southern side of Carnedd Llewelyn a dam has also been built at Llugwy, and an open leet has been cut along the 1,300 feet contour to convey the waters of Llugwy and the area above the leet into Cowlyd Lake.

12. The hydraulic development scheme provides for cutting further leets to secure the water available at the higher levels and impound these waters in the storage reservoirs of Eigiau and Cowlyd, which have been constructed for that purpose. In all, a total storage of over 600 million cubic feet is now available for power purposes, with a catchment area of nearly 20 square miles.

13. The existing power plant now operates under a head of 1,030 feet. A 36-inch welded steel pipe-line conveys the water to the power house below, at 24 feet above sea level, giving a net head of 1,006 feet.

14. In order to supplement the supply of power to the North Wales Power Company, there are now installed two 1,200 k.w. 3 phase Alternators coupled to the existing Pelton Wheels, in lieu of the D.C. Generators, which have temporarily been removed.

The plant installed at Dolgarrog consists of:—

3	1,000 k.w. Direct Current Sets	.....	3,000 k.w.
2	1,200 k.w. Alternators	.....	2,400 k.w.
1	150 k.w. Works Alternators	.....	150 k.w.
1	30 k.w. D.C. Lighting Set	.....	30 k.w.

Total 5,580 k.w.

15. Under the scheme for supply in the North Wales area, in conjunction with the North Wales Power Company, a new Power Station, of at least 30,000 k.w.,

will be built at Dolgarrog. Two 5,000 k.w. sets are now on order, with a new pipe-line of 4 feet 3 inches diameter. These sets will generate at 6,600 volts, stepping up to 35,000 volts for the transmission lines along the coast, and to supplement the existing supply to the North Wales Power Company.

Proposals are also in being to step up to 110,000 volts in an outdoor sub-station to form part of a main 110,000 volt ring system, connecting Dolgarrog Power Station with the proposed Maentwrog Station, and transmitting power in bulk to the eastern area of the North Wales and South Cheshire Electricity District.

No. 19.

CHESTER, RIVER DEE AND EATON HALL.

Limited to 150.

AN Excursion has been arranged to Chester and the River Dee, leaving about 9.30 a.m. and arriving back about 7.30 p.m.

Lunch will be served at Chester, and afterwards at 2 p.m., by kind invitation of His Grace the Duke of Westminster, the party will leave by private steamer from The Groves for Eccleston Ferry. They will then walk through the grounds of Eaton Hall, the residence of the Duke of Westminster, up to the Hall itself, where they will be entertained to tea.

The steamer will return from the Iron Bridge (close to Eaton Hall) about 5.30 to Chester. The train will leave Chester about 6.45.

Cost approximately 7/-.

Full particulars to be obtained from Messrs. Thos. Cook & Son in the Reception Room.

No. 20.**ISLE OF MAN (Day Excursion).**

THERE is a morning boat to the Isle of Man, leaving Liverpool 10.30 a.m., arriving Douglas about 2 o'clock. After about two hours ashore, the boat leaves Douglas at 4 p.m., arriving Liverpool Landing Stage about 7.30 p.m.

First Class return fare, 12s. 6d.

Tickets for this excursion are obtainable from Messrs. Thos. Cook & Son in the Reception Room.

No. 21.**LAKE DISTRICT (2 Days.)**

It has been suggested that some Members would like to have a two days' tour in the Lake District. The following is a rough outline of the proposed journey:—

By rail (3rd class) from Liverpool to Windermere. On arrival at Windermere motor coaches will be in attendance to drive the party to Bowness for lunch. After lunch the motor drive will be continued through Low Wood, Ambleside, Rydal, Grasmere, Thirlmere to Keswick (The Keswick Hotel).

Sunday, September 16th.

In the morning a motor drive will be taken round Lake Bassenthwaite, returning to The Keswick Hotel for lunch. After lunch the drive will be continued to Ullswater, Patterdale, Kirkstone Pass to Windermere (L.M.S. Station), where afternoon tea will be taken. The journey will then be continued by rail (3rd class) from Windermere to Liverpool.

Cost, £3 3s. 9d.

Tickets, and all information, to be obtained at Messrs. Thos. Cook's Office in the Reception Room.

No. 22.**LLANDUDNO AND BEAUMARIS BY SEA.**

THE steamer leaves the Liverpool Landing Stage at 10.45 a.m. and arrives Llandudno 1 o'clock; it then goes on to the Menai Straits, calling at Beaumaris, Bangor and Menai Bridge, arriving Menai Bridge about 2.30.

The boat returns from Menai Bridge at 3.40, calling at the same places as on the outward trip, arriving back in Liverpool at 7.30.

Fares: Liverpool and Llandudno, Saloon, 8s. return. Liverpool and Menai Bridge, Saloon, 10s. return.

Tickets and all information can be obtained from Messrs. Thos. Cook & Son in the Reception Room.

No. 23.**LAKE VYRNWY—LIVERPOOL WATERWORKS.**

Limited to 150.

Cost, 20/-.

Leaders.—Colonel J. R. DAVIDSON, C.M.G., Liverpool Water Engineer.

J. SANDEMAN ALLEN, Esq. } For the
ARNOLD RUSHTON, Esq. } British Association.

The party will meet on the Liverpool Landing Stage and take the 9.10 boat to Birkenhead (Woodside). A special train will leave Birkenhead (Woodside) Station at 9.30 a.m., arriving Llanfyllin 11.30 a.m. Motor Coaches will meet the party and convey them to Lake Vyrnwy, arriving about 12.30, where they will be met by Colonel J. R. Davidson, Liverpool Water Engineer, when lunch will be given by invitation of the Water Committee of the Liverpool Corporation.

After lunch the party will split up into sections, each under a guide. Maps and full particulars of

the Liverpool Waterworks at Lake Vyrnwy will be given to each member on the train so there will be time to consider which party each member would like to join.

Those interested in afforestation could visit the Nurseries and Plantations by car and on foot, also the wood wool plant and hurdle-making. There are two motor launches which will take members around the Lake, giving opportunities of visiting the Plantations and some of the Works. There will also be parties to visit the Dam (for particulars see an article written by Colonel J. R. Davidson in the Handbook, 'Merseyside'), also the following works.

STRAINING TOWER.—Water is drawn from the Lake close to the surface, whatever level of the Lake may be. It passes through two 'U' tubes to the inside of the Tower, where it is drawn through cylindrical copper gauze strainers. Passing from the bottom of the Tower it is carried by means of a concrete culvert laid below the bed of the Lake to the Hirnant Valve shaft. The mechanism by which the water is drawn off from the Lake and admitted to the Tower at the desired levels, and also the elaborate arrangements for raising and washing the strainers when dirty, will be seen in operation.

COMPENSATION WORKS. DAILY COMPENSATION GAUGE HOUSE.—Daily compensation 10 million gallons per 24 hours. The discharge of 10 million gallons per day is given through a sharp-edged rectangular orifice precisely 12" deep and 37·438" wide in a vertical plate. The level of still water is adjusted to a vertical point projecting upwards exactly 11·904" above the top edge of the notch, and the lower edge is 12" above the bottom of the basin. The Gauge House contains an elaborate arrangement whereby the delivery from the compensation orifice may be checked at any time.

MONTHLY COMPENSATION GAUGE.—The monthly compensation (being additional to the daily compensation) amounts to 40 million gallons a day, and is given on

four successive days in each of the eight months from February to October inclusive. The water is measured through four orifices, each of the same dimensions as that through which the daily compensation is paid.

FLOOD GAUGE ON RIVER VYRNWY.—Length of Gauge 80 feet. This gauge measures the whole of the yield of the Vyrnwy Gathering Ground which is not taken to Liverpool. The depth of water passing over the gauge is continuously recorded upon an automatic recorder.

NORTH-EAST DISCHARGE TUNNEL.—Contains one pipe 39" diameter, with valves in duplicate, for releasing surplus water; also apparatus for recording the level of water in the Lake.

The parties visiting these works could also make a tour of the Lake by car, calling at the hurdle-making depôt and wood wool plant.

After tea, by invitation of the Liverpool Water Committee, the motor coaches will leave Lake Vyrnwy at 5 o'clock for Llanfyllin, where a special train will be waiting. Dinner will be served on the train, and Birkenhead will be reached at 9.45 p.m.

No. 24. Section A.**STONYHURST COLLEGE.**

Limited to 150.

Leader.—T. E. LESCHER, Esq. (for the British Association).

Cost, 9s. approximately.

The party will leave Exchange Station 9.40 a.m., arriving Whalley 11.52 a.m. Char-a-bancs will convey them from Whalley to Stonyhurst. On the return journey the train leaves Whalley 5.12 p.m., arriving Exchange Station 6.23 p.m.

The College authorities have very kindly offered to entertain the party to lunch and afternoon tea.

STONYHURST COLLEGE lies in the valley of the Ribble, about 14 miles from Preston, and close to the boundary between Lancashire and Yorkshire. The estates of the College were owned as far back as 1298 by the Bailey family. In 1377 Richard Bailey, who married the daughter and co-heiress of Sir Richard Shireburn, took the name of his wife. It is this name which is identified with the ancient mansion of Stonyhurst. The part of the original house which now stands was commenced in 1592 by Sir Richard Shireburn. It consists of the towers, and the south side of the central quadrangle, containing the Hall or Banqueting Room, now the Boys' Refectory, and the Long Room or Gallery, which originally looked out on the south side to the gardens. The cupolas which crown the turrets were added by Sir Nicholas Shireburn in 1712-13. Originally a fine flight of steps led from the court to the Banqueting Hall. These were removed when the quadrangle was completed in 1856 from designs drawn by Father Richard Vaughan, S.J., his new buildings containing the handsome library. A curious memorial of Sir Nicholas' time is to be seen in the court, in the water pipes, to which are attached shields bearing the

arms of the families through alliance with which the property had come into his possession. To Sir Nicholas also we owe the long avenue and the square-cut ponds in front of the building. As one faces this west front of the College one sees the Infirmary (1844), connected by a corridor with the north wing, and the Church similarly connected with the south wing. The Church was built in 1832-6, from the designs of Mr. J. J. Scoles, who drew his inspiration from the Chapel of King's College, Cambridge.

By a happy coincidence, in the very year, 1592, when Sir Richard Shireburn was building his mansion, the College of which it was ultimately to be the home, was founded at St. Omer, in Artois, by Father Robert Parsons, S.J., to provide a place of education for the children of English Catholics during the Elizabethan persecution. Before the outbreak of the Civil War, the number of the boys had risen to as many as 200. In 1762, owing to the hostility of the Parliament of Paris to the Jesuits, the College emigrated to Bruges, where it enjoyed the special favour of the Empress-Queen Maria Theresa. But in 1773 the insistence of the Bourbon princes succeeded in inducing Pope Clement XIV to suppress the Society of Jesus. The College was closed, but only temporarily, for the very same year the Prince-Bishop of Liège gave his favour and cordial support to the establishment by the staff of the College, now secularised, of an Academy. Thus its corporate existence was preserved. Finally, in 1794, the approach of the French Revolutionary armies drove this English College back to its native land. The loyalty of Thomas Weld, of Lulworth, a descendant by a collateral line of the Shireburns, and a former student of Bruges, led him to offer the mansion of Stonyhurst to his former masters. Twelve boys accompanied the Fathers from Liège. To-day (1923) the number of the boys, including the Preparatory School at Hodder House, about a mile distant from the College, is 400.

The buildings constituting the South Front, replaced

a former block erected in 1808, and were commenced in 1876 from the designs of Dunn and Hanson. They consist of a central block with two towers having copper cupolas, which is flanked by two wings, that to the west being the house of the Community. These buildings contain all the rooms necessary for school purposes. On the lower corridor are the washing-place—all large rooms at Stonyhurst are called places, a word reminiscent of the origin of the College in France—shoe-places, armoury, playrooms, reading rooms and library, gymnasium abutting to the north, and in the basement rooms for music and drawing. On the same level is the chemical laboratory, a covered playground, a swimming bath, the boys' carpenter's shop, and a realistic miniature rifle-range.

The upper corridor contains the school-rooms, the study-place, and the Academy or Exhibition Hall. At the east-end is the religious memorial to the 165 boys who laid down their lives in the War, and adjoining it, to the north, the physics laboratory, a substantial part of the war memorial. At the west end of this corridor is the beautiful domestic chapel, entirely English work, including the alabaster altar, and the fine panelled reredos. The top storey of this building is devoted to the boys' dormitories. The south front measures in a straight line 560 feet, the central block having a length of 280 feet, and each of the wings 140 feet. The wings project 100 feet in front of the central block, giving a total frontage of 760 feet. The style of architecture is Jacobean, to harmonise with that of the Shireburn mansion.

The 'Long Room' in the Shireburn house, to the south side of the quadrangle, contains many fine pictures, and the collections of the famous naturalist, and alumnus of Stonyhurst, Charles Waterton. The 'Great Hall,' now the boys' refectory, has a memorial of the visit of Oliver Cromwell to Stonyhurst, in a table on which he slept on the night of August 16th, 1648. Below the 'Long Room' is the Bailey Room, the original Chapel of the Shireburns, with a fine Gothic

window. From the Refectory a flight of steps leads to a very beautiful Sodality Chapel, designed by Mr. Buckler. To the left, or on the north side of the quadrangle, is the Library. It contains many treasures, among them a fine collection of illuminated MSS. of biblical, liturgical, artistic, and antiquarian interest. Here can be seen St. Cuthbert's MSS. of the Gospel of St. John, from the seventh century, written on vellum, entirely in uncials, and the 'Horae' of Mary Queen of Scots, carried in her hand to the Scaffold. A very valuable collection of Incunabula and Aldines, the gift of the tenth Lord Arundell of Wardour, a boy at Stonyhurst in 1796, and added to by a bequest of the late Dr. Vertue, Bishop of Portsmouth, as also many fine etchings by Durer, are in this part of the library. The three rooms constituting the library are adjoined by a fourth, devoted to the natural history and geological collections. It only remains to mention, as a complement to the main block of buildings, the Power House with its twin turbine engines, from which heat and light are distributed over the whole establishment.

The Gardens are laid out in the Dutch style, and owe their origin to Sir Nicholas Shireburn (c. 1700). Originally they extended to the house. The two handsome summer houses were also built by him, after the designs of Sir Christopher Wren. In the Gardens stand the Observatories. Their origin, as a meteorological station, dates from 1838. The first magnetic report was issued in 1865, the continuous photographic records of the magnetic elements was begun in 1867, the instruments having been purchased by a grant from the Royal Society. In 1865 the observatory containing the 15-inch equatorial was constructed, originally an 8-inch, the larger object-glass having been subscribed for in 1889 by his friends and admirers, as a memorial to the late Father Perry. In 1881 the continuous series of solar drawings was commenced, and a great impetus to stellar spectroscopy was given by Father Sidgreaves in 1889. A Milne Seismograph, part of the equipment of Captain Scott's first Antarctic expedition,

was acquired by favour of the Royal Geographical Society in 1909. It was replaced this year (1923) by a Milne-Shaw instrument, the gift of the Royal Society. The motto of the Shireburn family was '*Quant Je Puis.*' The College has adopted it, as a symbol of aspiration to ever-continued progress.

No. 25. Sections B and M.

NANTWICH AREA AND HASLINGTON.

Limited to 20.

Leader.—W. B. MERCER, Esq., M.C., B.Sc.

The party will leave Woodside, Birkenhead, at 10 o'clock, by char-a-banc, proceeding direct to Haslington Lactose Factory, Nantwich. The afternoon will be spent on Cheshire Farms in the area, as far as time permits.

Cost, 7/6.

THIS portion of the Cheshire Plain has always been noted as the centre of the Cheshire Cheese Industry; and it is for this reason that the Ministry of Agriculture has selected Haslington as the centre for its Lactose Factory. The Lactose Factory has been opened by the Ministry to demonstrate the possibility of utilising the surplus whey of the cheese-makers. The problem of economically treating a raw material containing about 6·5 per cent. of total solids is dealt with as simply as possible.

Slate tanks of approximately 3,000 gallons capacity are provided for the reception of the whey, which is pumped as required into steam-heated wooden vats, fat being removed by passing the liquid first into a De Laval separator. The acidity is adjusted to a convenient degree and the liquid heated to about 95°C. to coagulate the Lactalbumen, and filtered. The clear

filtrate is now neutralised with lime, and again passed through the filter-press to remove the precipitated calcium salts.

A series of multiple effect Kastener evaporators concentrate the product to a syrupy consistency, the syrup being further concentrated in a Vacuum pan to the graining point, when the products are allowed to flow into crystallising vats. The crystals are drawn off and separated from the mother liquors by means of a centrifuge of the basket pattern. The resulting crude Lactose is dried on trays in a stove and stored pending conversion into the technically pure product. The molasses are re-treated and further crops of crude Lactose secured.

One of the great difficulties in a works of this kind lies in the seasonal nature of its activities. Surplus whey only being available during the summer months, the plant must perforce stand idle for the remainder of the year. To obviate this waste, an attempt is being made to store sufficient crude Lactose during the busy period to tide over the winter season, and then utilise the plant for the refining process.

Such a factory must have relatively large supplies of whey near at hand, for unless the liquid is dealt with speedily fermentation sets in with loss of sugar content. To a great extent, therefore, the works is dependent upon the cheese factories and farms in the immediate neighbourhood. It is hoped, so far as time permits, to visit one or two of the more interesting cheese farms in the locality, and thus obtain an insight into the conditions under which the ancient Cheshire cheese industry is carried on.

No. 26. Section C.**LAKE VYRNWY DISTRICT.**

Limited to 25. Cost 17/6.

Leaders.—Dr. GERTRUDE ELLES (President of Section C).
W. B. R. KING, Esq.

Time Table.—Leaving Landing Stage by 8.50 a.m. boat for Birkenhead (Woodside) take 9.5 a.m. train from Woodside to Gobowen, where char-a-bancs will meet the party. The return journey will be made from Gobowen by 6.2 p.m. train, reaching Woodside 7.25 p.m.

The party will go to Ty-Cerig to visit several important sections in the Marchnant and Blaen-y-cwm valleys, where exposures of Valentian, Ashgillian and Caradocian beds (sandstones, mudstones, shales, etc.) occur containing graptolites, trilobites, etc.

Members going on this excursion must provide themselves with luncheon to be eaten on the way.

No. 27. Section D.**DREDGING EXPEDITION, LIVERPOOL BAY,
on the S.S. 'JAMES FLETCHER.'**

By kind permission of the Lancashire and
Western Sea Fisheries Committee.

Limited to 20.

Leader.—Professor W. J. DAKIN, D.Sc., F.L.S., F.Z.S.

Cost.—There will be a charge of 10s. part cost towards lunch (which will be provided on board) and gratuities.

The s.s. 'James Fletcher' will pick up the party at the Birkenhead Landing Stage (details as to time will be obtainable in Section D Room).

The boat will then run out to sea, where a number of hauls with trawl will be made on suitable ground.

The steamer will return in the afternoon.

No. 28. Section K.**INGLEBOROUGH.**

Limited to 25.

Leader.—Mr. ALBERT WILSON, Havera Bank, Sedbergh.

Price, 17/6 approximately.

The party will go by motor char-a-banc to Ribbleshead. Visit to Pothole at Wethercote. Ascent of Ingleborough. Examination of limestone pavement flora. Return by char-a-banc.

Time of starting and further particulars will be obtainable in Section K Room.

SUNDAY, SEPTEMBER 16TH.

No. 29.

LLANDUDNO AND BEAUMARIS BY SEA.

There will be a day trip to Llandudno and Beaumaris.

For details see Excursion No. 22, the only difference being that the fare is 2s. more on Sundays.

Tickets and all information may be obtained from Messrs. Thos. Cook & Son in the Reception Room.

No. 30. Section C.

[FLINTSHIRE.]

Leaders.—Sir AUBREY STRAHAN.

Professor P. G. H. BOSWELL.

E. MONTAG, Esq.

Limited to 30.

Cost (not including tea), 6/6.

(N.B.—Members joining the excursion must take lunch with them to be eaten on the way.)

Cross to Birkenhead (Woodside) by boat leaving Landing Stage at 10 a.m. (fare, 2½d.). Leave Woodside in special motor char-a-banc at 10.15; proceed across Wirral to the Victoria Jubilee Bridge over the Dee Channel to Queensferry; then up Ewloe Hill, with the coal mines of Buckley ahead, and along the main road for Northop and Holywell. The road ascends to the 500 feet contour line and keeps above this line for three miles, giving a fine panoramic view over the Dee and Wirral. In the Halkyn Hills to the left are the Lower Carboniferous series—chert and limestone; on the right

immediately below are the Holywell shales, which are worn down to a shelf, into which has been cut the peculiar upper portion of the Nant-y-Flint.

The car will be left, and a visit paid to a section of the shales, and from thence a walk up the dip slope to the extensive quarries in chert and the top beds of the limestone at Waenbrodlas (see Hind and Hobbs, *Geol. Mag.*, 1906).

Rejoining the motors proceed over Holywell Common to Llanasa, and through a dry valley in the limestone to Gwaenyssgor and Dyserth; afterwards passing through Rhuddlan and over the tidal portion of the Clwyd to St. Asaph and up the Elwy valley to Pont-yr-Allt-Goch.

St. Asaph stands on a ridge of Boulder Clay between the Clwyd and Elwy, which have cut their valleys in the clay-covered plain. On both sides of the valley at Pont-yr-Allt-Goch a purple sandstone occurs, overlying Carboniferous Limestone; and looking up-stream the Cefn gorge cut in the limestone can be seen, and also the hills in the Silurian district of the Denbighshire moors.

Then passing through Trefnant and over the Clwyd, the party will leave the car and proceed by a footpath to Lleweni Hall for tea (about 4 p.m.), after which walk to Bodfari to rejoin the car.

At Bodfari the Carboniferous Limestone may be seen on the north faulted against the Silurian. The sequence and structure of the local Ludlow beds will here be described, and if time permits a brief visit will be made to the sections at Bryn Goleu.

Proceeding up the valley of the Wheeler, thickly covered by boulder clay, the eskers, which form a feature of the glacial deposits there and as far as Mold, will be noted. At Rhydymwyn the River Alyn issues from a fine gorge, and is closely followed as far as Mold, where the fine esker of Bailey Hill will be passed.

Crossing the Alyn, the main road to Queensferry will be taken, and Birkenhead reached between 7.30 and 8 p.m.

No. 31. Section K.

Mr. T. R. BULLEY'S GARDENS, NESTON.

Limited to 30.

Price, 2s.

The party will travel by motor 'bus from Birkenhead (Woodside), leaving early in the afternoon.

They will then make a tour of the alpine gardens and greenhouses.

Full details to be obtained in Section K Room.

MONDAY, SEPTEMBER 17TH.

No. 32.

BOOTH STEAMSHIP CO. LTD.
R.M.S. 'HILDEBRAND.'

Limited to 250.

Leaders.—CHARLES BOOTH, Esq., Chairman of the
Booth Steamship Co. Ltd.

E. E. FLETCHER, Esq., Director.

ELLIS K. YATES, Esq. (for the British
Association).

By invitation of The Booth Steamship Co. Ltd. a tender will be at the Liverpool Landing Stage at 2.45 p.m. to take Members out to the R.M.S. 'Hildebrand,' which will be anchored in the River Mersey.

After inspection of the vessel, tea will be served on board.

The tender will return about five o'clock.

THE Booth Line was founded in 1866 by Mr. Alfred Booth and the Right Honourable—then Mr.—Charles Booth, when the two small steamers 'Augustine' and 'Jerome' inaugurated a steamship service between Europe and North Brazil. Communication had previously been restricted to sailing vessels. This enterprise was soon justified, and other steamers were added to the fleet.

In 1869 the Red Cross Line was founded with the object of sharing in this growing trade, and the two Lines played an important part in the development of the great Amazon Basin.

In 1882 a service between New York and Brazil was started, and in 1901, 34 years after the foundation of

the Company, the Booth and Red Cross Lines were amalgamated under the name of The Booth Steamship Company Limited.

At the beginning of the present century short tours were arranged to Portugal and Madeira, and a few years later Spain was included. The careful organisation and the attention shewn to passengers, both on board and abroad, soon made these tours exceedingly attractive to the travelling public, and their popularity rapidly increased up to the outbreak of the Great War. The fleet then consisted of the six fine passenger liners 'Hildebrand,' 'Hilary,' 'Antony,' 'Lanfranc,' 'Anselm,' and 'Ambrose,' six new passenger and cargo steamers of the intermediate class, and a number of well-found cargo carriers.

THE GREAT WAR.

The Booth Line played a far from unimportant part in the European conflict. Up to 1917 the ships were singularly immune from loss, but in that year the enemy took heavy toll of the fleet, seven ships being sunk.

On the outbreak of war the Government chartered the 'Lanfranc' and 'Antony' to convey part of the Expeditionary Force from Ireland to France. Towards the end of 1914 the 'Hildebrand,' 'Hilary' and 'Ambrose' were taken over by the Admiralty, and after being heavily armed were employed as Armed Merchant Cruisers. They formed part of the famous Tenth Cruiser Squadron, which did invaluable service in maintaining the Blockade.

The 'Hilary' was torpedoed and sunk off the Shetlands in May, 1917, but the 'Ambrose' and 'Hildebrand' escaped unscathed. The 'Ambrose' was bought by the Admiralty, and having been converted into a Mother-Ship for Submarines is now a unit in H.M. Fleet. The 'Hildebrand' was returned to the Company, and is now employed on her lawful occasions. The 'Lanfranc,' when being used as a hospital ship, was sunk by torpedo in the Channel in April, 1917. Other ships of the Booth Line were employed as Fleet

Auxiliaries and Transports, and the remainder continued to help, performing the essential duty of maintaining the country's trade.

POST-WAR.

Since the War the Booth Line ships have run regularly between Europe and Pará and Manáos up the River Amazon, and Maranhão, Ceará and Tutuía Bay (Parnahyba) on the North-east Coast of Brazil. There are also sailings at definite intervals between New York and the principal ports in North and South Brazil, including, among the others, Maceió, Pernambuco, Bahia, Rio de Janeiro, Santos and Rio Grande do Sul. In pre-war days the Company's ships sailed both from Liverpool and New York to Iquitos in Peru, over 2,000 miles up the Amazon, but this service has been temporarily suspended: communication, however, has been maintained by the Amazon River Company's steamers plying between Manáos and Iquitos in conjunction with the Booth Line.

THE BRAZIL TRADE.

The chief exports from the Amazon ports of Pará and Manáos are Rubber and Brazil Nuts: of the latter about 35,000 tons were shipped to Europe and the United States last year. Other products are Balata, Cocoa, Cotton, Cottonseed, Hides, Maize and Timber. From the North-east Coast ports come Babassú, Tucum and Ucuíuba Kernels, Carnaúba Wax, Cotton, Cottonseed, Farinha, Hides, Maize, Rice and Starch. Carnaúba Wax, Cocoa, Coffee, Hides and Skins are despatched from the Mid and South Brazil ports to the United States.

THE 'HILDEBRAND.'

The 'Hildebrand,' twin screw, 7,000 tons gross register, the largest of the Booth Line fleet, and the biggest ship that has ever steamed 1,000 miles up a river, was completed in 1911 by Scott's Shipbuilding and Engineering Company, Greenock.

The principal dimensions and features are:—

Length, 456 feet.

Breadth, 54 feet 3 inches.

Depth, 38 feet moulded to Shelter Deck,
30 feet to Upper Deck.

Machinery, Quadruple Expansion; I.H.P., 5,600.

Speed, 15 knots.

Cargo capacity, 4,160 tons deadweight.

There is accommodation for 207 first class passengers, for whom 1, 2, 3 and 4 berth cabins are provided on the Shelter and Upper Decks, including two handsomely furnished Cabines de Luxe with private bathrooms. The cabins are fitted with electric fans and mosquito screening for use in the tropics. The principal public rooms are the large Dining Saloon, Music Room, Smoking Room, Lounge and Verandah Café. There is a spacious Promenade Deck and a Sports Deck. A swimming bath can be rigged up on the fore deck. The Galleys and Pantries are thoroughly up to date, and enable the cuisine to be maintained at the level of a first class hotel. The accommodation for 444 third class passengers is situated on the Upper and Main Decks aft.

The Engines are specially balanced to reduce vibration to a minimum.

The Wireless Room is placed on the after end of the Boat Deck. A Gyro Compass is carried in addition to those of the ordinary type.

The 'Hildebrand' soon after completion proceeded to Spithead to be present at His Majesty's Coronation Review on 24th June, 1911, where her smart appearance and graceful lines caused favourable comment.

THE AMAZON CRUISE.

After the War, it was not found possible to continue the short tours to Spain and Portugal, but the Booth Line decided that the Amazon offered an intensely interesting and little known field for the travelling public. Consequently, in 1922, six weeks' cruises were

organised and run by the 'Hildebrand,' and this departure has fully justified itself, as the cruises immediately achieved popularity. The visits to Oporto, Lisbon and Madeira, the nine days steaming from Madeira to Brazil over the deep blue tropical sea and the arrival at Pará, the gateway to the Amazon, are a fitting preliminary to the voyage of 1,000 miles up the greatest of all rivers to Manáos. The 10 hours' passage of the famous 'Narrows,' the apparently never-ending but ever-varying forest, the brilliant bird and insect life make this four days river journey a unique experience. From Manáos river expeditions are made into the forest and to view the great Victoria Regia Water-lilies which abound in the creeks. Few who have made the cruise have failed to feel the attraction of the great mysterious river, with which the Booth Line is so closely associated.

No. 33.

BRITISH INSULATED AND HELSBY CABLES LTD., PRESCOT WORKS.

Limited to 500.

Leaders.—A. J. MACPHAIL, Esq.

W. H. ROBERTS, Esq., F.I.C. (for the British Association).

The party will leave St. George's Hall in special tram cars at 2.30, to arrive at the Works about 3 o'clock, leaving by car for Liverpool at 5.30.

By kind invitation of British Insulated and Helsby Cables Ltd. the party will be entertained to tea about 5 o'clock.

It is particularly requested by the Directors of British Insulated and Helsby Cables Ltd. that no one connected with the manufacture of electric cables takes advantage of this invitation.

THIS large and most interesting works, situated at Prescott, Lancashire, only a few miles from Liverpool, is

admirably laid out and equipped for the manufacture of paper insulated cables and their accessories.

Established in 1891, for just over 30 years the business has been expanding and developing.

Some idea of the steady growth of this successful firm may be formed when it is mentioned that in 1896 the boundary walls surrounding the factory measured approximately 220 yards; to-day they form a girdle of two miles, enclosing 30 acres of land, of which some 18 are roofed over, whilst the authorised Capital is £3,000,000.

Leaving the Entrance Hall and Offices, we proceed to the cable-making portion of the factory, passing down what is known as the Old Export Department, where formerly was done the loading and despatching of the various products of the firm, nowadays, however, it is used mostly for the unloading of 'Goods Received,' and is equipped with three overhead travelling cranes lifting up to 15 tons.

At the foot of a gentle declivity, which marks the junction of the old factory with the new portion, we come to the Scrap Copper Melting Furnaces and see the scrap copper baled under hydraulic pressure, melted and run into billets, with suitably chamfered ends, for easy introduction into the reduction rolls.

Passing into the Rolling Mill we arrive at what is, perhaps, the most spectacular of the processes: here we see the ingots, or billets, re-heated in special muffles, introduced to the rolls, and thence the red-hot copper rod slides in snaky convolutions upon the polished steel floor of the mill. As the rod is passed from pass to pass of the reduction rolls, it gains in speed, and no little experience and sleight of hand is required to catch, direct, and control it in its sinuous journey to and fro, until it finally is caught up on to a power-operated winder, and is quickly run into a coil, to be rushed away to the cooling and pickling baths.

We pass into the Wire Drawing Shop, where a multiplicity of machines are drawing down through dies the wire to innumerable sizes, from the largest sizes of

trolley wire, to the finest instrument wire 1 mil. in diameter.

Adjacent to the Wire Mill we also find the Annealing Furnaces, wherein the wire is raised to the necessary temperature in a water sealed retort, the heated metal thus never coming into contact with the air, and consequently no oxidation can take place, the wire leaving the water clean and bright, after passing through the furnace on an endless chain conveyor.

We now retrace our steps up the old Export Department, and visit the Stranding Shops, and see the bobbins filled with the bright copper wire revolving rapidly through the air. Here we find the wires combined to a stranded conductor, coiling slowly on a drum at the end of each machine.

Passing from the Stranding Shop down what is known as the Ovens passage, where the Paper Insulated Cables are dried, simply, or in special vacuum drying ovens, as necessitated by their specification, we visit the Paper Insulating Department, and here again we see the rapidly revolving bobbins, this time filled with paper strip, and hear the swish of the paper as it is lapped, layer on layer, upon the stranded conductor.

The object of the paper being laid on in spiral strips will be readily grasped when it is remembered that paper possessing such little elasticity, it is essential that the dielectric shall permit of a certain amount of slip between adjacent surfaces or the cable could not be bent without fracture of the paper insulation.

The Impregnating and Lead Covering Department is the next to be visited, and here we see the vacuum impregnating chambers, compound tanks and lead presses. In this Department fascinating and highly important processes are carried out, as dictated by scientific research, experiment, and years of experience. The compound used, it is claimed, is unique as regards the very best combination of great dielectric strength, sufficiently high insulation resistance, and sufficient fluidity at all ordinary temperatures to render the cable flexible. The lead covering presses are huge

hydraulically-operated units which form a lead sheathing on the cable as it passes slowly through the press.

To follow the cable on to the Armouring Department, we now pass on through the Old Export Department, under the bridge, and pass along the new, or present Exporting Department—a splendidly designed and constructed steel frame shop, 500 feet long, served by a high speed overhead travelling crane of 15 tons capacity. The floor is laid with granite paving blocks, having heavy section grooved railway tracks, sunk flush, and the Department is thus equally suitable for the finished product to be loaded direct into railway trucks, or on to motor wagons. On our way to the Armouring Shop, we pass the Test and Tank House, wherein are three large water tanks for the immersing of the lead covered cables. Proceeding to the Armouring Shop a little further on, we are again in a finely designed shop containing the Armouring Machines. Here it is most interesting to see the lead covered cable receive its coating of bitumen, layer of hessian tape, steel wire, or steel strip armour, more bitumen, further layers of tape, and lastly receive a coat of whitewash as it is wound on the final drums.

To return to the Test House, this splendidly equipped building was laid out for the final testing of the finished cables, and contains a very fine selection of instruments for these purposes. Leaving the Test House we pay a visit to the Cotton Covering Department, and see the rapidly revolving spools of cotton which cover the wire. Before returning to the older portion of the factory, we visit the Telephone Cable-making Department, and there again we see the processes of stranding, paper insulating, and the laying up of the pairs, which number anything from 1 to 1,000 or more.

We have now made a fairly comprehensive tour of the Cable-making portion of the factory, but we can now see the Tinning Shop, where the copper wire passing through the tinning bath comes out with a silvery coat of tin.

We must next visit the Enamelled Wire Department, and here we see some of the very latest machines designed for this particular process.

Adjacent to this Department we see the Iron and Brass Foundries, both well equipped for dealing with a large volume of business in cast-iron, malleable iron, and non-ferrous castings. Close at hand we notice the large building of the Pattern Making and Pattern Storing Department.

Returning under the tunnel, we now find ourselves in what is known as the Electrical Fittings Department. This large Department is where the various accessories are manufactured, and is equipped for the building of Resistances, Electric Welders, Tramway and Electric Railway Overhead Gear and Fittings, Boxes, Pillars, Meters, Ceiling Fans, and a host of smaller fittings. Several interesting hours can easily be spent wandering around this Department alone, and even the most casual visits will prove far more interesting than pages of descriptive matter.

Passing on we visit the Aluminium Department, and here see aluminium sheets and sections of all the usual commercial sizes, the Department being equipped with its own Sheet and Rod Rolling Mills, Wire Drawing and Extruding Plant—all specially designed for dealing with aluminium.

In addition to the Departments already visited, there is a large Joinery and Building Department, and here again, in addition to the maintenance work of the Factory, new constructional work, etc., which is needed from time to time, many hand-carts, tool and drum wagons are built for outside customers.

Returning towards the General Offices and Entrance Hall we pass the large Power Station, which not only provides all the electrical energy for the whole of the factory, but, in addition, provides the District Lighting for some miles round. It stands conveniently near the railway siding, and is equipped with slack handling elevators, etc.

A little distance from the works is the Works

Canteen, adjacent to the Sports and Recreation Fields, where the workpeople are able to purchase, at reasonable prices, meals which can be consumed amidst clean and healthy surroundings, quite separate from the works environment. The large Dining Hall is laid with a spring dancing floor, and has a stage at one end, and is in frequent use during the winter evenings for dances, concerts, lectures, etc.

This brief and sketchy outline of a tour through the Prescott Works of this important concern can in no sense deal adequately with such a volume of processes, nor can it detail the various types of machines, many of them specially designed and constructed by the Firm's own staff: it can only, in the very baldest manner, suggest to the visitor what to look for, and as already pointed out, a few hours spent wandering round the factory will prove far more interesting and instructive to anyone engaging in the great Electrical Industry.

No. 34.

LEVER BROTHERS LTD., PORT SUNLIGHT.

Limited to 450.

Leaders.—MEMBERS OF THE BOARD OF DIRECTORS
(for Lever Brothers, Ltd.).
E. GABRIEL JONES, Esq., M.Sc., F.I.C.
(For the British Association).

Cost, 1/6.

Time Table.—The party will assemble on the Liverpool Landing Stage for the 2.30 boat to Birkenhead, Woodside Ferry, and will leave Woodside Station at 2.55 by special train, arriving Port Sunlight private station a few minutes later.

Messrs. Lever Bros. Ltd. have kindly invited the Members of the British Association to tea after the visit, and a special train will convey the party back again.

PORT SUNLIGHT AND ITS FACTORY.

PORT SUNLIGHT and the Factory with which it is intimately associated present the spectacle of industrial and domestic life united in agreeable relationship. It was one of the first practical examples of the application 'of the art and skill of the town planner and the domestic architect to the problem of housing an industrial community,' and it has served as a model for social experiments in different parts of the world.

When the first sod was cut by the late Lady Lever on the 3rd March, 1888, it was upon an inhospitable marshy territory of 56 acres, intersected by tidal creeks. It is from the principal of these, from the tributary of the Mersey known as Bromborough Pool, that the village derives its appellation of 'Port.' To-day the works and village cover an area of 423 acres, and the mud flats and gullies have given place to the parks and well-ordered streets and homes of a thriving community of 6,000 inhabitants.

The then Mr. W. H. Lever, embarrassed by the limitations of a factory at Warrington which could not cope with the growing public demand for the new 'Sunlight' soap (a factory whose productive capacity had in two years been increased from 20 to 450 tons of soap per week), found on the Cheshire bank of the Mersey 'a rural district where ample acreage could be secured adjacent to both rail and water transport, with reasonable facilities for obtaining the necessary amount of labour.'

Its 1,200 houses are tenanted by employees of the Company, who thus participate in the prosperity-sharing regime promoted by Lord Leverhulme, by virtue of which rentals are not fixed upon an economic basis, since they are only intended to cover maintenance cost and to provide 1% for depreciation.

A further and notable development of 'prosperity-sharing' resides in the Co-Partnership Scheme founded in 1909 by Lord Leverhulme. To-day any employee who is 21 years of age and has had twelve months'

service with the firm is entitled to apply to become a co-partner, his only obligation being 'not to waste time, labour, materials or money, and loyally and faithfully to further the interests of Lever Brothers, Limited, and Associated Companies and his Co-Partners.' Co-partners receive dividends on the amounts of their accumulated Partnership Certificates, which are allotted annually, at the rate of 5% less than that received by the ordinary shareholders for a particular year.

Lord Leverhulme, in July, 1922, inaugurated a scheme by which any co-partner who is out of work has added to the State unemployment allowance such a sum as makes up a full half of his standard week's wages. The same benefit is furnished for four weeks in the event of illness. Furthermore, each co-partner is presented with a life insurance policy of the minimum amount of £100, which, in the case of superior workmen and women may be increased to £1,000. For foremen and forewomen this gratuitous life insurance ranges from £200 to £2,000, and for managers and directors from £400 to £4,000. The scheme is non-contributory, and does not affect the full Trade Union rates of wages, which are the minimum paid by Lever Brothers to all in their employ. There is established also a system of grading by which superiority of workmanship and service is rewarded by increments of pay varying from 4/- to 11/- per week.

In the course of a tour of the factory, visitors are introduced to the fascinating processes associated with the production of dainty toilet articles in the works of the Vinolia Company. They may observe the progress of the perfume from the laboratory until it appears in its cut and decorated bottle; the manufacture of lip salve, of dentifrices, of pomades, of brilliantine and toilet powders. Through departments in which are being made some of the ten million wood boxes used in the course of a year at Port Sunlight, the visitor passes to the pan rooms and witnesses the

actual soap-making. From its liquid condition in the great 60-ton pans, the course of the laundry soap is followed until—the crude lye withdrawn and sent on its way to the Glycerine Refinery—it pours down wooden conductors into the cooling room. Here it remains hardening for about a week, when it is ready to be cut into slabs and bars, and finally stamped into the twin tablet which is wrapped by deft-fingered girls and bears the mark of 'Lever' 'as a guarantee of purity and excellence.'

By means of a well-equipped Printing Department, occupying over five acres, Port Sunlight is able to deal with all its own printing requirements, including the preparation of three magazines, of a technical journal, and of the thousands of line blocks issued yearly for newspaper and magazine reproduction by the Advertising Department.

In this and several other respects Port Sunlight is independent of outside resources for the various energies necessary to the maintenance of its great manufacturing plant. The water supply, for example, is derived from four artesian wells with an hourly capacity of 45,000 gallons, and its electric current comes from Lever Brothers' Power House at Bromborough.

The present capacity of the factory is for an output of 4,000 tons of soap a week, the raw materials for the manufacture of which are obtained mainly from the Company's plantations and oil mills in West African, the Belgian Congo, Solomon Islands and the Philippine Islands.

Port Sunlight, of course, is only the centre of a corporation whose ramifications are world-wide, and which has factories in France, Belgium, Holland, Switzerland, United States, Canada, Japan, South Africa, Australia and New Zealand.

There are surgeries, rest rooms and baths in each factory, a fully-trained First-aid and Ambulance Corps, and a splendidly-equipped Fire Brigade.

THE VILLAGE.

Notable among the public buildings with which Port Sunlight is generously endowed is the Lady Lever Art Gallery, a memorial to Lord Leverhulme's late wife, opened in December, 1922, by H.R.H. Princess Beatrice. Its architecture is in the simple classical style, and it houses a private collection of furniture, statuary, porcelain and pictures, which comprise a rich national possession. The oil paintings include a Titian, works by Reubens, Romney, Sir Joshua Reynolds, John Hoppner, Thomas Gainsborough, John Constable, John Crome, Madame Le Brun, William Etty, Sir Thomas Lawrence, Sir Henry Raeburn, and (among modern artists) by Lord Leighton, W. Holman Hunt, Sir J. E. Millais, Sir Edward Burne-Jones, Sir W. Q. Orchardson, Solomon J. Solomon, Sir Luke Fildes, Fred Walker and Herbert Draper. In the water colours Peter de Wint, J. M. W. Turner, David Cox, George Barret, Copley Fielding, William Henry Hunt, George Cattermole, G. J. Pinwell and Sir Hubert von Herkomer are represented. The famous 'Hunts of the Emperor Maximilian,' from the Gobelin Factory, and several Mortlakes give distinction to the tapestries. Chinese porcelain and Wedgwood are represented in collections of great variety and completeness; and there are a number of 'period' rooms, including one painted and stencilled after the manner of an apartment at Malmaison, and filled with Napoleonic relics.

The noble monument in the heart of the village commemorates the sacrifice of nearly 500 men who fell in the Great War, and honours the memory of four thousand employees of Lever Brothers who joined His Majesty's Forces.

Christ Church (interdenominational), built in the late perpendicular Gothic style, is the village place of worship, and other buildings and institutions include the Auditorium, a large hall accommodating over 3,000; Gladstone Hall, the well-equipped theatre and concert room, opened in 1891 by the Rt. Hon. W. E.

Gladstone, M.P.; the Hulme Hall, now serving as a restaurant; the Lyceum, where the Staff Training College is established; Church Drive Day School, the Technical Institute, the Collegium, the Cottage Hospital, Lever Free Library, Co-partners' Club, and Girls' Social Club. There is a large open-air swimming bath, and adjoining the village are about 200 acres allotted to lawn-tennis courts, cricket pitches, football and hockey grounds, and an athletic stadium with accommodation for 20,000 spectators. In Bolton Road, and close to the main Chester Road, is the Bridge Inn, a fully-licensed hostelry. A pretty park known as the Dell, and large areas devoted to allotment gardens are other features of a village whose pleasant aspect and social significance are studied by many thousands of visitors in the course of every year.

No. 35.**LIVERPOOL HOUSING SCHEME.**

Leader.—A. E. SHENNAN, Esq.

2-30 p.m.—Leave St. George's Hall (Plateau) by char-a-bancs, *via* London Road, Pembroke Place, West Derby Street and Edge Lane Drive, through Elms House and Edge Lane Drive Estates.

Proceed *via* Queen's Drive, Allerton Road and Mather Avenue, and drive through Springwood Estate.

4.0 p.m.—Proceed *via* Woolton Road, Allerton Road, Queen's Drive, past the Bungalows at Knotty Ash Camp, and drive through Walton-Clubmoor and Larkhill Estates.

5.15 p.m.—Tea and light refreshments at Larkhill Mansion.

6.0 p.m.—Return to town.

(NOTE.—A descriptive brochure of the Liverpool Housing Schemes will be issued later.)

MEMO *re* LIVERPOOL HOUSING SCHEME.

Prior to the War, the activities of the Liverpool Housing Committee were wholly confined to dealing with insanitary property, the inauguration and carrying out of schemes for housing the dispossessed population on the demolition areas, and the management of the artizans' and labourers' dwellings in the densely-populated quarters of the City.

Since the year 1864, when there were in existence 22,000 insanitary, back-to-back houses, the work of demolition and rebuilding on the site has been a continuous policy, and if the War had not intervened, the whole of these insanitary houses would have been dealt with. At the present time there only remain about 2,600 of this type of house, and schemes have been prepared for their removal.

In addition, there is a considerable number of otherwise insanitary houses to be dealt with. The erection of new houses for the working classes by private enterprise, which averaged up to the year 1911 over 1,000 per annum, was also brought to a standstill by the War, and there was in 1919 an estimated shortage of something like 15,000 houses in the City.

The duty of overcoming this shortage devolved upon the Municipality under the provisions of the Housing, Town Planning, etc., Act, 1919.

The following table shows the total number of houses contracted for, tenanted and in course of construction on the various estates up to 2nd August, 1923:—

Estate.	Total No. of Houses Contracted for			No. of Houses Completed.			No. o Houses in progress	Remarks
	Type 'A'	Type 'B'	Total	Type 'A'	Type 'B'	Total		
Elms House	252	...	252	252	...	252	...	
Larkhill	470	1,583	2,053	470	1,579	2,049	4	
Fazakerley	62	150	212	62	150	212	...	
Edge Lane Drive	495	290	785	265	227	492	293	
Walton-Clubmoor	469	409	878	305	193	498	380	
Springwood, Allerton	224	784	1,008	210	730	940	68	
Partly developed Estates	...	554	554	...	554	554	...	
Penrhyn Street ...	26	...	26	26	...	26	...	On site of Unhealthy Area.
Mason Street	28	...	28	28	...	28	...	Do.
Blenheim Street	18	...	18	18	...	18	...	Do.
Woolton	24	...	24	24	...	24	...	(Tenements) Not Assisted Scheme.
	2,068	3,770	5,838	1,660	3,433	5,093	745	
Wooden Bungalows, Knotty Ash ...			488			488		Converted Military Huts.
Total			6,326			5,581	745	

On partly-developed estates in various districts in the City, the Corporation entered into agreements with firms who had had the handling of such estates in pre-war days to erect a total of 554 pre-war parlour-type houses, situated in Garston, Dingle, Wavertree, Anfield and Walton.

These houses have been completed and in occupation for some time, and contain parlour, living-room, scullery, bath, w.c., and three bedrooms, and are let at an inclusive rental of 14s. 9d. per week. The whole of these houses are of brick construction.

KNOTTY ASH CAMP (63 Acres).

As a temporary measure, pending the erection of the more permanent buildings, the huts on the Knotty Ash Camp, used by the American troops during the War, were purchased and converted into Bungalows by contract and direct labour, making a total of 488 Bungalows, rapidly providing accommodation for about 2,400 persons.

These Bungalows contain living-room, scullery, bathroom, w.c., and two, three or four bedrooms, and have hot water and electric light, the inclusive rents varying from 8s. 6d. to 12s. 6d. per week, according to size.

ELMS HOUSE ESTATE (Area, 24 Acres).

This comprises a total of 252 houses completed and occupied for some considerable time. The houses are all of the non-parlour type, and contain a living-room, scullery, three bedrooms, bathroom, w.c., with gardens at back and front. Electric light is installed. The inclusive rental for these houses is 14s. 9d. per week. The whole of these houses are constructed in brick.

EDGE LANE DRIVE ESTATE (Area, 90 Acres).

About 500 houses are completed and occupied on this estate. A small number are constructed of concrete under the Waller and other systems, whilst the remainder are in brick. A further 285 houses are rapidly nearing completion. The accommodation

provided in the houses is similar to that on the other estates. The inclusive rentals are:—Non-parlour type, 14s. 9d. per week; parlour type, 17s. 6d. per week. Provision is made for Recreation Grounds, Allotments, and sites for Churches, etc.

SPRINGWOOD ESTATE (Area, 184 Acres).

The natural surroundings of this estate are very beautiful. 940 houses have been completed, whilst a further 68 are almost ready for occupation.

Sites for 14 shops have been sold on a 99 years' lease, whilst sites for Churches, etc., are under consideration.

This estate has a Recreation Ground comprising 17 acres, and an old Mansion House known as "Springwood." Provision is made for Allotments, etc.

The greater portion of the houses on this estate have been constructed of a special form of concrete block.

The accommodation and rentals of the houses are similar to those on the other estates.

WOOLTON.

The 24 houses at Woolton have been erected in School Lane, to allow of alterations being made to houses on an insanitary area in this district. These 24 houses contain living-room, scullery, three bedrooms, bath-room and w.c., and small garden. The inclusive rental is 10s. 3d. per week.

WALTON-CLUBMOOR ESTATE (Area, 310 Acres).

A large number of the houses on this estate have been erected and completed by direct labour in concrete block construction with external colouring. Many interesting experiments were made in order to overcome the shortage of bricklayers and plasterers which arose during the period of the construction of these houses.

There will be 469 non-parlour and 409 parlour types of houses when the whole are completed.

These houses have similar accommodation and inclusive rentals to those on the other estates.

Provision is made for Recreation Grounds, Allotments, etc.

LARKHILL ESTATE (Area, 231 Acres).

There are 2,049 houses completed and occupied on this estate, comprising 470 Type 'A' houses and 1,579 Type 'B' houses, mostly of brick construction. There are nearly eight miles of streets on the area.

A Recreation Ground is provided, whilst sites for 41 shops in the centre of the estate have been sold. A number of these shops have been erected and are tenanted.

Sites for Churches for the different denominations, doctors' residences, etc., have been sold.

An ornamental Garden and Lake at the junction of Lisburn Lane, Larkhill Lane and Adshead Road, about four acres in extent, have been converted into a Public Garden for the district.

FAZAKERLEY ESTATE (Area, 35 Acres).

There is a total of 212 houses on this estate, comprising 62 Type 'A' and 150 Type 'B' houses, which have been completed and in occupation for a considerable time.

UNHEALTHY AREAS IN CENTRE OF CITY.

It will, therefore, be seen that whilst the Liverpool Corporation have been carrying out extensive housing operations in the suburbs they are also keeping up, as far as possible, their great record for the clearance of slum property in the more central portions of the City, and the rehousing of the dispossessed.

No. 36.**LIVERPOOL SALVAGE ASSOCIATION.**

Limited to 50.

Leaders.—Commander I. J. KAY, O.B.E., R.D. (Chief Surveyor).

Commander G. J. WHEELER.

Engineer-Commander W. W. HEWITT.

J. SANDEMAN ALLEN, Esq. (for the British Association).

The party will meet at the Liverpool Salvage Association's headquarters at the Canning Pier Head, 2 minutes' walk from the Liverpool Landing Stage Pier Head at 3.0 p.m.

There they will see the pumping, air-compressing, and other salvage plant; also the ocean-going salvage steamer "Ranger," if in dock.

No. 37.**MECCANO LTD.**

Limited to 50.

Leaders—F. HORNBY, Esq., Managing Director
HAROLD COVENTRY, Esq. (for the British Association).

The party will leave St. George's Hall by motor bus at 2.30, and will arrive at the works at 3 o'clock.

The Directors of Meccano Ltd., have kindly invited the party to tea during the visit. The visit will finish about 5 o'clock.

It is now some twenty years ago since Meccano first came into existence. At that time it was sold under the name 'Mechanics Made Easy,' and the business was conducted from a small room in James Street, Liverpool. From that modest beginning has sprung the

world-wide organisation of to-day, with Head Office and Factory at Binns Road, Liverpool, and associated companies at Elizabeth, New Jersey and New York, Toronto, and Paris. In addition to these factories, Meccano depôts have been established in Australia at Sydney, and in New Zealand at Auckland; in South Africa at Johannesburg, Cape Town and Durban; and elsewhere at Brussels, Basel, Amsterdam, Genoa, Alexandria, Constantinople, Bombay, Buenos Aires, Monte Video, and Valparaiso.

Meccano thus covers the world, and it has been found necessary to print Meccano literature in sixteen different languages, even including Chinese. Boys are the same all over the world, and Meccano makes a universal appeal, whether the lucky recipient of an Outfit be located at the Equator or in the Antipodes.

In addition to Meccano, the firm manufactures the Hornby Clockwork Trains, together with a variety of model rolling stock and rails, points and crossings.

With the exception of the gelatine used for the carriage windows in the Hornby train rolling stock, every part of Meccano and Hornby trains is manufactured from raw material in the factory at Binns Road, where the buildings cover some five acres.

The factory may be roughly divided into three main sections:—(i) The Press Department; (ii) the Automatic High-Speed Machine Department; and (iii) the Testing and Packing Department. In the Press Department, huge presses stamp out the Meccano steel strips, perforating them with the equi-distant holes at the same time. A special staff of tool-makers is constantly at work on the tools, so that a clean stamp is always obtained, and the strips are free from rough edges. After passing through the Barrelling Room, where they are rotated in drums until perfectly smooth and clean, the strips are ready for plating. The plating plant is one of the finest in the country, and here the strips are nickel-plated, and other component parts of the system brass-plated.

Perhaps the most interesting department is the

Machine Department, where the automatic machines turn out with marvellous rapidity a variety of parts used in the Meccano production.

Amongst the most interesting machines in this room is the battery of bolt-making machines. These make bolts from reels of wire, bumping heads on them and cutting them into the requisite lengths at something like a gross a minute. Other machines cut slots in the bolt heads and thread the shafts by an ingenious operation. Elsewhere the bolts are tested for accuracy by a labour-saving device, the necessity for which will be realised when it is learned that over forty millions of Meccano nuts and bolts are produced annually.

The chain-making machines, that knit Meccano sprocket chain from a coil of wire, are also wonderfully ingenious.

The beautiful finish of the Hornby trains is obtained by a special enamelling process. The enamel is sprayed on by compressed air and the finish is obtained in the process of drying by heat.

The component parts of the Hornby trains are assembled and tested in a spacious room, covering an area of over 25,000 square feet. Here also the trains are tested by being made to run a number of times around their miniature tracks. It is always difficult to persuade our young visitors to leave the tables at which the girls are testing these trains, and it seems difficult for the juvenile mind to comprehend why it should be necessary for any firm to *pay* anyone to run trains around a track, when so many voluntary workers could be found for this section!

Another large room that is beautifully light and airy is the Packing Department. Here, as elsewhere in the factory, it is evident that the workers appreciate the healthy conditions under which they work.

No. 38.**THE UNION COLD STORAGE CO. LTD.**

Limited to 100.

Leaders.—F. J. GIBBS, Esq.

B. J. KIRKHAM, Esq.

J. G. LEGGE, Esq. (for the British Association).

Time Table.—Assemble at the Pier Head Station of the Liverpool Overhead Railway at 2.30 p.m., and book to Alexandra Dock Station.

The visit will last about an hour and a quarter.

THE Liverpool Overhead Railway is the only Elevated Railway in the United Kingdom, and taking the train Northward a panoramic view is obtained of the Northern section of the Estate of the Mersey Docks and Harbour Board, the River Mersey, and the residential borough of Wallasey on the opposite side of the River.

The first portion of the Docks as seen from the railway carriage window are the older and smaller docks, now utilised for steamers engaged in the Irish and Coastal trade. Further on are seen the more modern and larger docks, accommodating the largest Passenger Liners and Cargo steamers.

One or two buildings on the journey are worthy of notice. After the train has passed Princes Dock Station, on the left is seen the Dock Board's Grain Warehouses, a substantial pile of buildings forming three sides of an oblong, in the centre of which steamers discharge their cargoes of grain. Soon after leaving Clarence Dock Station, on the right hand side, one notices a huge red brick building, the Dock Board's Tobacco Warehouse, filled entirely with tobacco in its natural state, and which is the largest warehouse building in the world.

Alighting at Alexandra Dock Station, the discharging shed at the Northern side of No. 2 branch Alexandra Dock is near at hand. This discharging berth is used almost exclusively by steamers discharging cargoes of

frozen meat. The meat is lifted from the frozen holds of the ships and landed on the quay, and is then passed on to electrically driven escalators, which carry the meat on to endless travelling bands running from the quay shed right into the Cold Storage building. Undue exposure to the atmosphere is thereby eliminated, and the frozen meat is transferred from the freezing hold of the ship to the freezing chambers of the cold stores within a period of a few minutes, which does not permit of any defrosting taking place.

Leaving the quay shed, the solid south wall of the Cold Store, across the roadway, conveys some idea of the size and capacity of the building, which is the largest and most modern Cold Store in Europe.

The building is erected in three separate blocks, and it is divided into six floors, some of which are further sub-divided, each floor or section being termed a 'chamber.' The capacity of the building under freezing temperature is:—

1,200,000 Carcases frozen Lamb, or
800,000 Carcases frozen Mutton, or
260,000 Quarters frozen Beef,

the latter commodity being the equivalent of 65,000 head of cattle.

On entering the building on the ground floor is seen the working platform on to which the meat is received and distributed to the chambers, and also where the meat is brought from the chambers for distribution throughout the country for consumption. The loading platforms surround the building on three sides, and in addition to loading motor vehicles, one hundred refrigerator railway meat vans each day can be loaded direct inside the Cold Store for despatch by any railway route out of Liverpool. The loading of the railway refrigerator meat vans within the Cold Store itself again minimises the exposure of the meat and ensures that it reaches its destination still in hard condition.

During hot weather, the receptacles provided in the railway vans are filled with ice and salt to assist in

maintaining the meat loaded in the vans at a low temperature.

The roof of the building is reached by a service of twenty-five electric lifts. The roof is a large covered area, with northern lights, devoted to the handling of the goods carried in the Cold Store. It is on this floor the endless conveyor bands from the discharging quay below deposit the frozen meat. Here it is sorted to the different classes and grades, and moved away on small trucks to the storage chambers. At another point on the roof, electric cranes discharge the contents of the Cold Storage Co.'s Refrigerator Barges, which have received their cargoes from steamers discharging in different Docks. At another point, electric band-saws are installed for cutting frozen meat to the requirements of the owners.

Descending by another lift, a halt is made on one of the chamber landings, from which direct access is obtained into one of the freeing chambers, the temperature of which is approximately 15° Fahr.

The chamber, which is typical of others in the building, will hold:—

120,000 Carcases Lamb, or
80,000 Carcases Mutton, or
26,000 Quarter Beef.

The chambers, which are cooled on the Direct Expansion of Ammonia System, are equipped with a total of 60 miles of cooling pipes.

The source of refrigeration is found in the Engine Room, which occupies a separate block of buildings to the north of the Cold Store itself. Here, electric current is received from the Municipal Power Station at 6,000 volts and transformed down to normal working voltage, and supplies the motive power to drive the three 80 ton ammonia compressors, and the whole electrical equipment of the Cold Store.

No. 39. Section C.**SCARTH HILL AND SKILLAW CLOUGH.**

Limited to 30. Cost, 4/6.

Leaders.—T. A. JONES and E. NEAVERSON.

Leave Central Technical School at 2.15 p.m. in special motor char-a-banc and proceed by way of Walton over the northern portion of the Triassic ridge; across the low-lying alluvial valley of the River Alt; through the mossland district about Kirkby, where in some places peat is still dug for fuel; and over a district covered by Boulder Clay and Shirdley Hill sand to Scarth Hill, near Ormskirk.

Scarth Hill is a slight eminence capped by the basement beds of the Keuper Sandstone, and on an old excavation the junction between the Keuper and the Upper Bunter is exposed, but somewhat obscured. The Upper Soft Sandstone here is interesting from the fairly uniform grading of the sand grains in the different beds and the large proportion of very well rounded grains.

Then proceeding past Lathom Park, where the Gannister beds come to the surface, cross the broad low-lying valley of the Douglas (covered with recent alluvium and peat) to Skillaw Clough, the ravine of a small brook in the bed and banks of which Permian beds are exposed. The sequence in descending order met with in passing up-stream is as follows: Grey magnesium limestone (about 6 feet thick); purple red fossiliferous marls (about 30 feet); soft bright red sandstone passing downwards into a hard brown sandstone (about 35 feet); underneath which are greyish purple shales belonging to the Millstone Grit series.

[Members of the party wishing to see an exposure of typical Millstone Grit—instead of the Permian beds—can do so in the neighbouring Parbold quarries.]

Rejoin the cars at 5.45 p.m., and return through Ormskirk, Maghull and Aintree, reaching Liverpool shortly after 7.0 p.m.

No. 40. Section F.**LIVERPOOL COTTON EXCHANGE.**

Limited to 50.

Leader.—Professor E. R. DEWSNUP, M.A.

The party will assemble at St. George's Hall
at 2.30 p.m.

The President and Directors of the Cotton Exchange have kindly invited the party to tea.

RECORDS show that Cotton was imported into Liverpool in small quantities in the year 1751, but there is little information as to the manner in which the business was carried on at that time.

The trade, however, gradually developed, until in 1882 merchants and brokers agreed to form an Association under the name of the Liverpool Cotton Association. This proved a highly successful development, and at the present time the Liverpool Market has become the greatest market in the world for the purchase and sale of actual Spot Cotton.

The Association is formed of approximately 600 members, many of whom specialise in different branches of the trade. An important section of the Members are Importers, who import Cotton into Liverpool from all the Cotton growing countries of the world. In some cases this Cotton has been sold before it actually arrives, while in other cases it is sampled on arrival, graded into various qualities, and kept in warehouses ready for the requirements of the spinners in Europe.

In addition to the importing section, a number of Members act as Spinners' Brokers, making purchases on their behalf and selecting Cotton according to their requirements. These brokers, by their long training, know exactly the class of Cotton that is required by the various mills, and when a spinner notifies his broker that he is in the market to buy Cotton, the broker duly announces this fact to merchants who may have suitable Cotton in stock. Thus, when the spinner arrives in

Liverpool, samples of different lots of Cotton are ready for his selection in the brokers' saleroom. After deciding upon the actual lot and quantity of Cotton that will fill his requirements, the spinner makes his purchase, and the broker sees that the transaction is properly carried out and the Cotton in due course forwarded to the mill.

A very important part of the machinery of the Cotton business is the 'Futures Market,' by which both the importer and the spinner can insure against a sudden advance or decline in the price of Cotton. Obviously it would take more space than is here available to enter into details regarding transactions in futures, which are inevitably highly technical, but this much may be said—without the Futures Market, with its expert diagnosis of future conditions and the stability and confidence promoted by the system of hedges that has grown up with it, the progress of the Cotton Trade, so vital an element in the prosperity of this country, would have been seriously retarded.

From the foregoing remarks something may be realised of the necessity and importance of the Liverpool Market, one of the peculiar advantages being that there is always a large stock of all growths of Cotton actually held in warehouse, from which buyers may make a selection, and further, once a purchase has been made, the Cotton can be held in Liverpool until the spinner needs it for consumption at the mill.

Out of a total import in the season 1921-1922 of 2,700,000 bales into the United Kingdom, 2,340,000 bales came into Liverpool. This is a slight indication of Liverpool's position; a position, however, which has not been built up in a few years, but is the result of years of work done by generation after generation of men who have been trained in the business both at home and abroad.

Under the rules of the Association, machinery has been provided for arbitration and appeals on the quality of Cotton tendered in fulfilment of contracts. Special forms of contract have been drawn up suitable

for all classes of business, and, after long and careful thought, a multitude of other rules have been made which help to make business easier and the Cotton trade one of the most highly organised trades of the country.

A Clearing House and Cotton Bank have also been formed, under the control of the Association, which facilitate the Weekly Settlement in the Futures Market, and through which payments are also made for purchases of actual Cotton. This obviates a great amount of work which otherwise would have to be done between firms, and replaces the system, which formerly obtained, of carrying large amounts of cash from office to office.

The present Exchange was opened in 1907, and was specially built for the Cotton trade. It contains numerous offices and salerooms, which are rented to Members, as well as the Arbitration and Appeal Rooms and other offices required for the working of the Association; altogether it is worthy of the many and important activities which it houses.

No. 41. Section M.

WIRRAL FARMS, CHESHIRE.

Limited to 30.

Leader.—E. H. RIDEOUT, Esq., B.Sc., A.I.C.

The party will leave Woodside (Birkenhead)
by char-a-banc at 2.0 p.m.

Cost, 2/6.

A SERIES of field experiments has been designed and laid down upon farms in the Wirral Peninsula. The chief object of these experiments is to discover how far different 'soil types' under similar climatic conditions justify modification in the manurial system. Representative fields have been picked out, and plots laid down on both arable and grassland. The soils of

the area for this purpose have been classified on a genetic basis upon the lines adopted by the Geological Survey. Fields have been chosen as far as possible typical of the three soil types, Sandstone of the Triassic series, Boulder Clays and Alluvium. Three classes of manures have been chosen, the particular variety sown depending on the crop and nature of the land.

The phosphatic manures are represented by *Superphosphate* (T.P.=30%), '*Ephos*' *Basic Phosphate* (T.P.=60%) and *Basic Slag* (T.P.=20%). *Sulphate of Potash* has been used throughout as a source of Potash. Nitrogen has been supplied either through *Nitrate of Soda* or *Dry Neutral Sulphate of Ammonia*. In each instance equivalent quantities of the fertilisers have been used to ensure comparative results.

A. GRASSLANDS.—Typical grasslands have been selected on each type of soil. At three centres trials of the fertilisers mentioned have been made on 1/10th acre plots in duplicate. At two of these centres 64 separate plots have been marked out, ensuring a sufficient number to observe the effect of each manure in combination, and used separately. On the remaining farm nitrogenous manures were omitted, reducing the number of plots to 32. Half of the field at each centre was cross-dressed with ground limestone ('*Carbo-Limo*') according to the previously ascertained Lime requirement. With the exception of Nitrogenous fertilisers manures were sown in November and December, 1922.

1. *Mr. F. Burgess, Arrowe House Farm, Woodchurch.*

Three years ley on heavy boulder clay soil, pipe drained 2 ft. 6 in. deep. Poor growth, no manuring for 2-3 years, except by grazing animals.

2. *Mr. T. Tottey, Grange Hall Farm, West Kirby.*

Old pasture, formerly the 'Park' of Grange Hall, now demolished. Very light thin sandy soil (Keuper

Sandstone). Turf fairly good but full of weeds, continuously grazed. No manures have been applied during recent years.

3. *Mr. T. Morley, Carr Farm, Saughall Massie.*

Old meadow, on alluvial silts, liable to flooding. Floods delayed sowing of fertilisers until January 26th. To be mown this season.

B. ARABLE.—The Arable crops for this season comprise Spring oats, potatoes, turnips and mangels. At each station 1/8th acre plots, in duplicate, have been marked out and sown with various combinations of well known standard fertilisers as used for the grassland.

1. SPRING OATS.

Mr. G. Lee, Parkgate House, Great Saughall.

Heavy boulder clay, well drained and fairly fertile, though not a good field by comparison with its neighbours. Oats were sown on the 17th April, 1923.

2. POTATOES.

Mr. T. Tottey, Grange Hall Farm, West Kirby,

Light sandy soil similar to A2. Previously down to clover and rye-grass for two years, ploughed in winter. Farmyard manure spread over whole field at the rate of about 10-15 tons per acre. Sowing completed April 24th.

3. TURNIPS.

Mr. A. S. Gaskell, Prenton Hall Farm, Prenton.

Boulder clay soil, on well-drained slope. Sowing of manures was delayed by weather conditions, so that the work was only finished on the 29th April.

4. MANGELS.

Sown on same field as Turnips under identical conditions.

Thanks are due to the following for supplying, free of charge, the fertilisers used:—

Superphosphate.....	Fertiliser Manufacturers, Ltd.
Ephos Basic Phosphate...	Messrs. Crookston Bros.
Sulphate of Potash.....	The Potash Syndicate.
Sulphate of Ammonia.....	British S.A. Federation, Ltd.
Nitrate of Soda.....	Chilean Nitrate Committee.
Carbo-Limo.....	Ship Canal Portland Cement Manufacturers, Ltd.

also to their advisory staffs for willing assistance in carrying out the trials, and to the farmers who have lent their fields for the purpose.

TUESDAY, SEPTEMBER 18TH.

No. 42.

**GLADSTONE DOCK WORKS,
MERSEY DOCKS AND HARBOUR BOARD.**

Leaders.—C. CONCANON, Esq., Outdoor Assistant to the General Manager of the Mersey Docks and Harbour Board.

ARNOLD RUSHTON, Esq. (for the British Association).

Time Table.—Assemble at Dock Office, Liverpool Pier Head, 2.30. Then the party will travel by special train on the Overhead Railway from James Street Station to Alexandra Dock Station, and, after inspecting the Gladstone Dock Works, will return by a special train at 4.30 from Seaforth Sands Overhead Railway Station to James Street Station.

THE construction of the Gladstone Dock System was first decided upon by the Mersey Docks and Harbour Board in 1906 when they obtained powers from Parliament to develop a portion of the land and fore-shore in their possession at the extreme North of their Liverpool Estate but, owing to the depression in the shipping trade in the years immediately following and to the outbreak of war in 1914, the scheme in its entirety is only now approaching completion. The new System will consist of a vestibule dock, two branch docks and a graving dock (also available as an ordinary wet dock), and will be connected directly to the River Mersey and, via the Hornby Dock, with the existing Northern system of docks.

RIVER ENTRANCE.

The River entrance to the new Dock System is one of the features of the scheme. This entrance is being constructed with a lock 1,070 feet long by 130 feet wide and a sill 20 feet below Liverpool Bay datum (i.e., 30 feet below Liverpool 'Old Dock Sill'), but the advantages to be derived from this gigantic lock perhaps will be appreciated best when it is explained that, not only will liners of dimensions yet unthought of be able to pass through at high tide, but, except for a few hours at near to the time of 'dead low' water of exceptional spring tides, it will be possible to 'lock in' large vessels of 28 feet draught of water at any time of the day or night—truly a remarkable feat at a river where the tidal range may amount to more than 30 feet. The lock will be served by three pairs of steel gates, a pair at each end and one in the middle, the centre pair being provided so that the full length of the lock can be divided into two sections in order to economise the loss of water when locking in small vessels; also to afford an additional safeguard should either of the other two pairs be temporarily out of commission. Instead of being opened and closed by hauling chains, the lock gates will be worked by rams on a patent system of Mr. T. L. Norfolk, M.Inst.C.E., the Chief Assistant to the present Liverpool Dock Engineer.

THE GLADSTONE DOCK AND GLADSTONE BRANCH DOCKS.

These docks, when completed, will add another $2\frac{3}{4}$ miles of quays to the Port of Liverpool and will be so deep that, even at the flood level of the River Mersey on the lowest neap tides, there will be a depth of 42 feet of water in them. The actual lengths of the Branch Docks will be:—No. 1, 1,420 feet; No. 2, 1,285 feet; while each will be 400 feet wide, with the quays 63 feet above the bottom of the docks. The lengths may appear small when compared with those of docks at some other ports but this has been designed deliberately by the Mersey Board who have always considered it a matter of the highest importance that

their dock berths should be easy of access both to the vessels using the docks and to the land transport dealing with their cargoes.

The sheds under construction at the new Dock System are to be on the same grand scale as the docks themselves. The shed on the South side of the Gladstone Branch Dock No. 1 will be 150 feet wide while those on the North sides of that dock and both sides of the Branch Dock No. 2 will be each 100 feet wide. The total area of the four sheds will be $13\frac{3}{4}$ acres but, as they are all to be treble storey sheds with flat roofs which will be available for cargo, the total area on which storage may take place will be 54 acres. Four lines of rails are to be laid at each berth, two on the quay side and two on the land side of each shed, while 30-cwt. moveable electric cranes will be available for the handling of cargo to and from ships' holds, and moveable 20-cwt. electric roof cranes will run along rails on the treble storey sheds to reach the interior of the sheds through roof and floor hatchways and command not only the two lines of railway on the land side of the sheds but also the roadway beyond those lines. In addition, power will be available in all portions of the sheds for connection to light mobile electric cranes, run-about trucks, etc.

GLADSTONE GRAVING DOCK.

This dock, which is the largest graving dock in Europe, is 1,050 feet long, 120 feet wide, has a depth of 19 feet below Liverpool Bay datum and is closed by a sliding caisson which maintains the water in the dock or excludes it therefrom according to the nature of the duties of the dock, either as a dry or a wet dock, for the time being. This dock was formally opened by H.M. King George V on the 11th of July, 1913, with an entrance direct from the river and has provided graving dock accommodation for the largest vessels afloat, in several instances providing the only graving dock accommodation in existence for those liners on the

European side of the Atlantic. The temporary entrance direct from the river is now being closed and the new entrance will be from the Gladstone Dock, so that vessels may enter the graving dock from the other North docks without having to go out into the river.

The Gladstone Graving Dock has been designed so that it may be used either as a graving dock or a wet dock, and on the North quay a single storey shed, 900 feet long by 100 feet wide, in two spans, has been provided with four 30-cwt. electric moveable cargo cranes to deal with importations and exportations, while on both sides and round the head of the dock, rails have been laid, on which works a moveable 5-tons steam crane for use in lowering into and lifting out of the dock the many articles of plant, etc., required in graving dock work.

In order that the dock may be rapidly cleared of water when required for use as a graving dock, five sets of centrifugal pumps have been installed, capable of developing a total of 5,000 horse power, and emptying the dock of its whole contents (amounting to about 44 million gallons, say 200,000 tons, of water) in $2\frac{1}{2}$ hours.

During the journey on the Overhead Railway to and from the Gladstone Dock Works, a good view of approximately one-third of the Mersey Dock Estate will be obtained. The first outstanding item of interest after leaving the Pier Head with its three large buildings, the Liver Building, the Cunard Building and the Head Office of the Mersey Docks and Harbour Board, will be noticed on the landward side of the line. This will be the Stanley Dock Tobacco Warehouse, which is the largest warehouse in the world, with its thirteen floors (containing no less than 36 acres), and accommodation for 70,000 hogsheads. Some idea of the size of this warehouse may be obtained when it is stated that it is 725 feet long, 165 feet broad and about 125 feet high from the street level, has a basement, quay floor and twelve upper floors, and required 27 million bricks and 6,000 tons of iron in its construction.

Further North on the riverside will be noticed many famous docks, with some of the largest liners in the world discharging and loading at their quays, while, after leaving the train at the Alexandra Dock Station, notice should be taken, when walking past, of the Union Cold Stores there, which are admittedly the largest and most modern in Europe.

No. 43.

LLAY MAIN COLLIERY, near WREXHAM.

Leaders.—E. A. HUGHES, Esq., General Manager.

PHILIP REA, Esq. (for the British Association).

Cost, 7s. 6d. Limited to 50.

The party will leave Liverpool Central (Low Level) Station by the 1.50 p.m. train, change at Rock Ferry, and arrive Chester 2.33 p.m. Motor Coaches will be waiting and will then drive to the Llay Main Colliery, arriving 3.15 p.m.

After the visit the Llay Main Colliery Co. Ltd. have kindly invited the Members to afternoon tea. They will then leave by motor coach at 5.45 p.m., and will catch the 6.30 p.m. train from Chester, arriving Liverpool Central Station at 7.12 p.m.

This Colliery, which belongs to the Llay Main Collieries Limited, lies 9 miles S.W. of Chester and $4\frac{1}{2}$ miles N. of Wrexham, in North Wales. The first pit was completed in May, 1916, and the second in August, 1916, but owing to war contingencies operations were suspended for nearly two years, and the Colliery is not yet approaching its maximum possible output. It is unique in North Wales both for size and up-to-date plant, and a model village is in course of construction about half a mile from the Colliery to accommodate the employees. A detailed description will be distributed to Members of the Association on arrival at the Colliery.

No. 44.

PLANTERS MARGARINE CO. LTD.

Limited to 300.

Cost, 1/6.

Leaders.—Members of the Board of Directors of
PLANTERS MARGARINE Co., LTD.

W. RIMMER TEARE, Esq. (for the British
Association).

Time Table.—The party will leave Liverpool Landing Stage by the 2.30 p.m. boat for Birkenhead (Woodside). A special train leaving Woodside Station will convey the party to Bromborough Port.

After an inspection of the Margarine Works, the party will be entertained to tea at Port Sunlight.

A special train will leave Port Sunlight about 5.30 for Woodside Station (Birkenhead).

THE Bromborough Works of the Planters Margarine Co., Ltd., were built during 1917-1918 to cope with the increased business hitherto carried on in the same Company's works at Godley, near Manchester, and form a factory on the most modern principles and equipped with the most up-to-date machinery.

There are two essential factors in ensuring the success of the manufacture apart from the materials and the processes, namely, a good water supply and complete control of temperature in the rooms and in the product at the various stages.

The water supply for the Bromborough Works is obtained from a deep artesian well sunk within the premises, and yielding 30,000 gallons of excellent water per hour.

For controlling temperatures extensive plants for heating and cooling are installed.

Cooling is effected by means of four large ammonia compressors, either through the medium of cooled brine or by direct expansion in a system of pipes in the various rooms. This cooling plant is one of the largest in the country.

The air in the rooms where cooling is not required is kept at the desired temperature by means of a number of plants which purify the air and regulate the temperature and humidity to the required degree, and distribute the air in the rooms through an extensive system of air ducts.

The machinery is all driven by electric motors and the electricity is generated in the Company's own power station. For repair and maintenance work, and for construction of special machinery, well equipped mechanics' and joiners' shops are available.

The numerous boxes in which the margarine is packed are made in a Box Making Department equipped with automatic machinery for box printing and box nailing.

An extensive conveyor system is visible everywhere in the factory, both gravity conveyors and belt conveyors being used as labour-saving devices for transporting full and empty boxes.

In the Despatch Department use is made of numerous electric auto-trucks conveying the goods from cold-storage to railway trucks.

The railway sidings serving the factory are arranged in such a manner that all raw materials and auxiliary materials enter the factory at one end and the finished articles leave the factory at the opposite end, thus rendering the transport of materials through the factory as simple as possible.

Bacteriological and Chemical Laboratories control raw materials, process and finished product, and facilities are provided in the neighbourhood for testing the products, when desired, by actual feeding experiments in a special laboratory stocked with suitable animals.

The workers are supplied by the Company with

suitable clothing daily, and a well-equipped laundry is attached to the works.

Extensive cloak-rooms and shower-baths are available for the employees, and keen attention is given to "Safety First" principles.

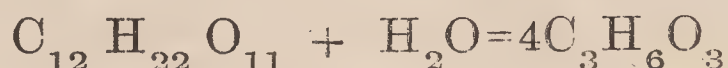
Similarly with those at Port Sunlight, the employees are participants in Co-Partnership Schemes, and Insurance Schemes against illness, unemployment and death.

The history of Margarine dates back to the Franco-Prussian War, when the French chemist—Mège Mouries—was commissioned by the French Government to carry out some experiments in order to produce a fatty food which could serve as a substitute for butter. The result of his work was the production of Margarine, and although methods and technique have changed since then, the principle underlying the manufacture is essentially the same.

Margarine is manufactured by enriching milk, separated or full cream milk, with fats other than butter-fat, in order to produce a concentrated creamy emulsion of a consistency similar to cream used for churning butter, and this emulsion is solidified by intense cooling, the excess moisture from the milk being removed by the subsequent kneading, and the margarine salted and worked by extra kneading in blending machines.

The milk, which is received from farms and milk collecting stations in the surrounding district, is pasteurized, and subsequently cooled to a suitable temperature for the souring or ripening process. During this process the milk is soured by the action of lactic acid bacteria, which are added as pure cultures of definite specimens selected in the bacteriological laboratory as most suitable for the process. This bacterium, when allowed to grow and develop in the milk, converts the lactose in the milk into lactic acid, and at the same time aromatic bodies are developed giving a flavour and aroma to the sour milk similar to that developed in cream when ripened for

butter-making. The generally accepted formula in accordance with which this change takes place is as follows :—



When about 0·5% of lactic acid has been formed in this way, curdling of the milk takes place, and further development of acid and activity of the bacteria is arrested by cooling the milk and keeping it for a few hours in the cooled state ready for the next process.

To the milk thus prepared is added a suitable blend of oils and fats in order to form a thick, creamy emulsion.

The oils and fats most generally used are refined beef fat (oleo margarine), refined hog fat (neutral lard) refined and deodorised cocoanut oil, palm kernel oil, arachis oil, cottonseed oil, sesame oil, etc. Hydrogenated fats are now also used to a large extent.

The blending of the oils and fats enables the margarine maker to impart to the margarine a suitable texture, and to regulate within limits the melting-point and consistency in accordance with the climatic conditions, as there is available a large range of fats and oils from very firm consistency to quite liquid.

When the emulsion of fats and oils and prepared milk is formed it is essential that it is solidified by instantaneous cooling, as slow cooling may cause the different constituents in the fat to segregate. The process adopted in this case is the so-called dry cooling process, where the liquid emulsion is pumped over chilled cylindrical rollers, cooled internally by means of circulating brine. On coming in contact with the chilled surface the emulsion at once solidifies, and is scraped off as thin flakes and drops into collecting wagons.

After the cooling follows a period of rest, the so-called maturing, to enable the flavour from the milk-phase in the emulsion to be absorbed by the fat, and after this maturing the flaky and granular substance is consolidated in kneading machines, from

which it emerges as a plastic mass of the right consistency and texture.

A further maturing follows, after which the margarine is salted and finally blended in special kneading machines, and it is now ready to be packed for despatch to distributors and consumers, although it is customary, particularly in the warmer time of the year, to cold-store the margarine for a few days.

No. 45.

WILSON BROS. BOBBIN CO. LTD.

Limited to 100.

Leaders.—A. HEATON, Esq., Works Manager.

J. B. DECKER, Esq. (for the British Association).

Time Table.—The party will leave at 2.0 p.m. from the Old Haymarket, close to St. George's Hall, by special trams for Garston.

After the inspection of the Works, Messrs. Wilson Bros. have kindly invited the Members to afternoon tea.

Special trams will convey the party back into Liverpool.

THE term 'Bobbins' will in many cases be associated with Sewing Cotton. This particular type is used once, its sole purpose being to serve as a vehicle for carrying and storing the finished sewing cotton until it achieves its final destiny. The Bobbin has then finished its career, as a Bobbin, but it may sometimes survive in some other capacity.

There is another type of Bobbin, infinite in variety, which never comes to the public notice, but which is a most important factor in the production of every class of textile fabric.

In the manufacture of yarn, whether it be cotton,

wool, silk, flax, ramie, or anything else, it is converted into a thread at the earliest possible stage. The thread may be thick and soft, or fine and comparatively hard, but it is immediately wound on to a 'Bobbin' of suitable size and shape ready for the next process, and thereafter its manufacture becomes a series of transitions in practically all of which Bobbins of varying kinds are used.

The Bobbin-making Industry is as old as the Textile Industry, though it is of limited extent, but it is an interesting fact that the British manufacturer occupies the premier position, particularly as to quality, and has always been the main source of supply for the world.

The Garston Bobbin Works, which adjoin the Garston Docks, are by far the largest and most efficiently equipped works of their kind in existence, just as the proprietors, Messrs. Wilson Brothers' Bobbin Co. Ltd.—who this year celebrate their Centenary—have for three-quarters of a century been the pioneers in every movement for the improvement of the industry.

The business was founded at Cornholme, Todmorden, in 1823, and up to 1902 the Company's headquarters were situated there. These Works are still carried on and, next to the Garston Works, are the largest in this country, employing 700 workpeople and occupying over seven acres of floor space.

The Garston Works commenced in 1894, and became the headquarters of the Company in 1902. They now occupy an area of over eleven acres and give employment to 1,300 workpeople.

They have been designed specially for the purposes of the Bobbin-making Industry, embodying the accumulated experience of seventy years, and are replete with the most efficient machinery and appliances, largely of the firm's own design and manufacture.

In addition to the Sawing and Woodworking sections, which in normal times consumed upwards of 35,000 tons of native timber and 12,000 tons of imported timber

per annum, the Works include a Metal Stamping Department with a capacity of over two million stampings per week, with a consumption of 800 tons of Tinplates, Brass and Copper Sheets per annum.

In the manufacture of Bobbins there is a very heavy percentage of wastewood, turnings, borings and sawdust, and the firm utilise this in their Chemical Departments for the production of Charcoal of various kinds, Pyroligneous Acid, Pyrolignite of Iron, Acetate of Lime, Acetate of Soda, Wood Naphtha, etc. etc.

The Works constitute a never failing source of interest to the Company's customers both at home and abroad, and have been visited from time to time by most of the leading technical bodies connected with the Cotton Trade of Lancashire, and in the opinion of experts these visits are a valuable adjunct to the training of men for responsible positions in the trade.

No. 46. Section A.

BRITISH OXYGEN CO. LTD., BOOTLE WORKS.

Limited to 25.

Leader.—J. RICE, Esq., M.A.

The party will assemble at St. George's Hall at 2.30 and will go by special motor bus to the Works.

After the visit they will return by special motor bus.

The Directors have kindly invited the visitors to tea during the visit to the Works.

THE PRODUCTION OF OXYGEN FROM LIQUID AIR.

THE production of Oxygen from Air by refrigeration consists of three distinct operations:—

1. Purification,
2. Liquefaction,
3. Rectification,

and each of these operations is conducted separately.

PURIFICATION.—Consists in removing principally CO_2 and moisture and incidentally those minute traces of other impurities such as mineral acids, H_2S , SO_2 , etc., etc., to be found in the atmosphere in all our manufacturing towns.

This is obtained by passing all the air treated through lime purifiers where it is caused to filter slowly through a mass of slaked lime where the CO_2 is absorbed according to the following equation:—



and the other acids, etc., form definite Calcium Compounds, the moisture being finally frozen out in the Interchangers, by the cold gases (Oxygen and Nitrogen) on their way out of the Plant.

LIQUEFACTION.—The now pure dry Air is compressed up to approximately 500 lbs. sq. in., in which process it becomes very hot and has to be cooled to the ordinary atmospheric temperature by passing through coils immersed in running water, after which it enters the Interchangers and is cooled by the out-going gases to a point below which water and CO_2 are frozen out solid.

The Air is now allowed to expand to a pressure of about 65 lbs. sq. in. and the drop of temperature due to expansion is such that the air leaving the expansion engine condenses, forming liquid air, and falls into a receiver in the base of the column.

Once a working quantity of liquid air has been obtained, then theoretically the heat absorbed in its evaporation should allow for the liquefaction of a further equivalent amount of air, but owing to heat losses it is found that, after getting the best return of liquid air possible by heat interchange, it is necessary to keep up the compression and subsequent expansion of the air to maintain the working quantity of liquid air.

RECTIFICATION.—The liquid air is forced up to the rectification column and there subjected to a process

of distillation similar to the distillation of alcohol in a 'coffee' continuous Still.

Here the liquid air is gently flowing downwards from one tray to another whilst the vapours rising are bubbling through it in each tray, with the result that the more volatile nitrogen is disengaged from the liquid and the less volatile oxygen is condensed; so that whilst the liquid on the top tray is poor in oxygen and practically pure nitrogen is bubbling through it and passing out of the Plant, the lower trays of the Still contain a highly concentrated liquid consisting of 98%—99% oxygen. At this point the rich oxygen liquid is drawn off the Still or rectifying column, and on passing into the Vapouriser it abstracts the very necessary latent heat passing from the liquid gaseous oxygen by the system of heat interchange already referred to. The arrangements are such that the oxygen leaving the Plant on its way to the Gas Holder is only 10°C., or 12°C. colder than the atmosphere, the nitrogen waste being the same.

No. 47. Section B.**JOSEPH CROSFIELD & SONS LTD.,
WARRINGTON.**

Leader.—W. DORAN, Esq., M.Sc.

Time Table.—The party will assemble at the Booking Office, Central Station, Liverpool, at 1.20. The train leaves 1.30, arriving 1.53 at Warrington. On the return journey the train leaves Warrington at 5.54.

Return ticket, 4/6.

Transport has been arranged to and from the Works.

At the Works the party will be received by Dr. E. F. Armstrong, F.R.S., D.Sc., Managing Director, Messrs. Joseph Crosfield and Sons, Ltd., President of the Society of Chemical Industry.

FOUNDED in 1815, the business of Joseph Crosfield and Sons, Ltd., has steadily grown until it is one of the largest of its kind in the world. Forty years ago there were less than 250 employees, whilst to-day there are more than 3,500. Besides making all kinds and varieties of soap, they are producers of Carbosil, Persil, Caustic Soda, Silicate of Soda, Glycerine, Portland Cement, Edible Fats, etc. The works occupy commanding positions on both sides of the River Mersey. The firm have their own fleet of steamboats, and are connected with three leading railways through their network of private sidings and lines. The manufacturing processes are carried out under expert scientific control in their various stages, the raw materials and finished products being especially subjected to close examination in order that the highest degree of quality and uniformity may be maintained. Whilst the various processes in use are the most modern of their kind, continuous research is being carried on with the view to improving existing processes and developing new

ones. Several entirely new technical processes have been originated in the works, the most important of these being the production of solid fats from liquid oils by the now well-known hydrogenation process. An entirely new building has been recently constructed upon the most up-to-date principles devoted to housing the plant of the firm's subsidiary, the Erasmic Company, Ltd., which manufactures the well-known toilet soaps, perfumes and specialities.

No. 48. Section C.

LEA GREEN COLLIERIES AND BRICK PITS.

Limited to 50.

Leaders.—T. A. JONES and C. B. TRAVIS.

Leave Lime Street Station by 1.30 p.m. train for Lea Green Station (return third class fare, 2s. 6d.). Examine the sections in the Middle and Upper Coal Measures exposed in the large brick pits at Lea Green. The Upper Coal Measures are here faulted against the Middle Coal Measures in one of the pits; and by the red and purple staining of their grits, marls and shales the Middle Coal Measures offer a sharp contrast to the greyish beds of the other series. The clay and shales are used in the manufacture of bricks, tiles and rough earthenware, and the adjoining brick-works may be visited.

The directors of the Sutton Heath and Lea Green Collieries Co. have kindly agreed to provide facilities for the descent into one of their coal pits of not more than 30 members of the party, while the others are visiting the sections exposed in the open brick pits which belong to the same Company. Members desiring to descend the pit must give in their names to the Local Sectional Secretary not later than noon on the day (Monday) preceding.

Then walk along the colliery railway line to another open brick pit at Thatto Heath (about one mile from Lea Green), where in a section of the Middle Coal Measures a seam of coal about six feet thick is exposed (and worked), immediately overlaid by several feet of boulder clay.

The return journey to Lime Street can be made by train either from Lea Green Station at 4.56, or from Thatto Heath Station at 5.9 or 5.34.

(Note.—Persons joining this excursion will obtain their own railway tickets.)

No. 49. Section D.

DELAMERE FOREST.

Leader.—Professor R. NEWSTEAD, M.Sc., F.R.S.

Price, 6s. approximately, not including tea.

The party will leave Birkenhead Ferry entrance at 2.30 p.m. and drive by char-a-banc through Wirral and *via* Chester to Delamere.

The excursion is one offering facilities to entomologists.

Arrangements will be made for tea at Delamere.

No. 50. Sections E. & F. (and others).

RIVER TRIP.

By kind permission of the Wallasey Ferries Committee, a Ferryboat is being placed at the disposal of Sections E. and F. Members of other Sections are invited to join the excursion, as the Ferryboat will hold about 1,000 people.

The course taken on this river cruise will cover about $18\frac{1}{2}$ miles, and will occupy about two hours.

Details of this excursion will be obtainable in the Section Rooms, but the Ferryboat will probably leave the Landing Stage (Pier Head) at 3-30 p.m.

No. 51. Section G.**GLADSTONE DOCK.**

There will be a sectional visit to the Gladstone Dock and Works at the same time as the general excursion (see No. 42).

Further particulars of the sectional visit to be obtained in Section G. Room.

No. 52. Section H.**INCE BLUNDELL.**

Limited to 25.

Leader.—Professor J. P. DROOP, M.A.

Cost, 2/6.

The party will inspect the Ince Blundell Collection of Pictures and Ancient Sculpture; also gems and prints, should the family be at home; but not otherwise.

For details, time, etc., please inquire in Section Room.

Special motor buses will take the party to and from Ince Blundell.

No. 53. Section J.**RAINHILL.**

Limited to 50.

Cost 2/6.

Special motor buses will take the party to and from Rainhill, and will leave St. George's Hall plateau at 2.30 p.m.

Further particulars of this excursion may be obtained in Section J. Room.

No. 54. Section K.**WEST LANCASHIRE SAND DUNES:
FRESHFIELD.**

Limited to 30.

Leader.—H. WHELDON, Esq.

Cost, 2/6.

The party will leave Exchange Station by the 2 p.m. train. The walk will extend over the sandhill area, and will give opportunities for the study of the flora of the "slacks."

Further particulars of this Excursion to be obtained in Section K room.

No. 55. Section M.**GARTONS LTD., WARRINGTON.**

Limited to 30.

Leaders.—G. P. MILN, Esq., J.P., F.L.S., E. H. RIDEOUT, Esq., B.Sc., A.I.C.

Cost 5/-.

THE party will travel by road, leaving Liverpool at 2 o'clock, visiting en route a farm typical of South-West Lancashire. The remainder of the time will be spent at Warrington, where Messrs. Gartons have kindly consented to conduct the party through their works. Messrs. Gartons, Ltd., was incorporated in 1898 to take over the work of the late Mr. John Garton, whose work on plant breeding for increased crop production was already well known. The marketing of 'regenerated' breeds of Cereals, with truly marvellous results, has made the firm's name renowned both here and abroad.

The work has been extended to roots, clovers and

grasses; recent strains of pasture grasses having attracted much attention. To carry on such work in a satisfactory manner requires both adequate experimental grounds and a thoroughly efficient cleaning plant. It is expected that by September 18th the harvest in the experimental grounds near by will be over, but ample remains in the works to attract the attention of all interested in seed production.

No less than eight 'batteries' have been installed for the cleaning and grading of cereal seeds, driven, in common with the remainder of the works, by electricity. Seed is elevated to the top floor and fed through nine distinct separators before reaching the bagging and delivery department at the ground level. The cleaning being performed by air currents, and grading by rotating cylinders lined with projecting teeth of various dimensions. Considerable expense is incurred in the separation of black from white oats or *vice-versa*. The crossing of black and white parents often gives rise to a number of 'sports.' These have to be picked out by hand whilst the seed moves slowly past the sorters on an endless belt. An alternative method would be greatly welcomed.

An ingenious machine has been devised by Professor Newstead, of the School of Tropical Medicine, Liverpool, for the drying of mangold seed. Serious losses have occurred in the past through the depredations of mites. Their rapid spread through stored seed necessitates continual vigilance; damaged seed has to be removed by repeated recleaning, the extra handling, together with the loss of material adding considerably to the cost of the seed.

It has been found that below a certain minimum moisture content, the mites are unable to exist; thus these pests could be kept under control if it were possible to dry the seed without injuring its germination capacity. This has been simply effected by rotating the seed in a large wooden drum, about six feet long by four feet in diameter. The inner surface, bearing projecting ridges, exerts friction in the mass of seeds,

and develops sufficient heat to drive off superfluous moisture, leaving the material an unsuitable breeding ground for the mites.

Various special machines exist for the separation and cleaning of clovers and grasses and other agricultural seeds. Of perhaps equal importance with the works department is the testing laboratory adjoining. Here frequent tests are made on the germinating capacity of the seeds produced, in addition to the tests performed at Cambridge. The germinators are of various patterns, some for use at ordinary temperature, others electrically heated according to the nature of the seed. An interesting point has arisen concerning the value of seed-testing with certain new varieties. In addition to laboratory tests the seeds are, of course, tested under field conditions, but, in one or two instances, both at Messrs. Gartons laboratory and at the official seed-testing station, have failed miserably in practice. This disturbing fact would be worthy of further investigation.

SEPTEMBER 19TH—24TH.

No. 56.

ISLE OF MAN (5 days.)

An excursion has been arranged to the Isle of Man directly after the Meeting in Liverpool, and a programme has been drawn up by a local Committee. The following particulars will show that those who are able to take part in this excursion will have a most interesting week-end.

The number is limited to 150, and the total cost (including travelling and hotels, etc.) will be about £7.

Those who wish to go on this excursion should communicate immediately with the Hon. Secretary of the Isle of Man Committee: W. Cubbon, Esq., The Manx Museum, Library and Art Gallery, Douglas, Isle of Man.

This excursion will be of particular interest to Archaeologists, Biologists, Botanists and Geologists.

There is excellent and reasonable accommodation provided at the various hotels and boarding-houses in Douglas. The delegates and their friends taking part in the excursion to the Isle of Man will be provided, by courtesy of the Isle of Man Board of Advertising, with their official guide in which they can find information as to hotels, etc.

RECEPTION ROOM.

By courtesy of the Committee of the Corporation, the Reading Room at Villa Marina will be placed at the disposal of the guests during their visit.

The guests will assemble at Villa Marina at 9.30 each morning for the excursions, and for the Sunday afternoon excursion at 2 p.m.

The Reception Room will be open from Wednesday evening at 8 o'clock, and each day from 9 a.m. for the issue of tickets in connection with the excursions, and supplying all necessary information.

PROVISIONAL PROGRAMME.

Wednesday, 19th September.

Party leaves Liverpool (Prince's Landing Stage) by the Isle of Man Steam Packet Company's fast mail steamer at 3 p.m., and arrives Douglas about 6-30 p.m.

The following excursions have been provisionally arranged:—

Thursday, 20th September.

EXCURSION TO THE SOUTH OF THE ISLAND.

Assemble at Villa Marina at 9.30 a.m. and leave at 10 a.m. prompt by motor coach, by way of the old Castletown road.

(a) Visiting Ballakelly Circle, Arragon Moar, Mull Circle. Lunch in the open on Mull Hill at 1 o'clock.

(b) As far as Castletown to the Stack of Scarlett (Strandhall). Dredging and tow-netting trip off Bradda Head. (Lunch). Port Erin Biological Station. Demonstration of the research work done at the Station. Join 'A' party at Rushen Abbey. If weather too stormy for the sea trip in the morning, an examination of the marine algae will be made at Pooilvaish and Strandhall, under the leadership of Mr. R. Bruce, of the Biological Station. Both parties to arrive at Rushen Abbey at 5 p.m., where they will be received by Mr. and Mrs. W. C. Cubbon, who invite them to take tea on their lawn. Leave Rushen Abbey at 5.30.

Members must signify at Villa Marina by 9.15 on Thursday morning which excursion ('A' or 'B') they will take, in order that seats may be provided in the respective motor coaches, and that sufficient boats may be provided at Port Erin for the sea trip.

Friday, 21st September.

MORNING EXCURSION TO THE WEST OF THE ISLAND.

Assemble at Villa Marina at 9.30 a.m., and leave at 10 a.m. prompt by motor coach for Peel, *via* Kirk Braddan, St. Trinian's, Tynwald Hill, and Bronze Age Cist to Peel Castle. Return *via* Lhergydhoo and the Kew Giant's Grave. Arrive Villa Marina at 2 p.m.

GARDEN PARTY AT GOVERNMENT HOUSE.

His Excellency Sir William Fry, K.C.V.O., C.B., and Lady Fry, have invited Members to a Garden Party at Government House, and cars will start from Villa Marina at 3 o'clock.

THE MAYOR'S RECEPTION.

The Mayor of Douglas (Mr. Alderman Crookall) and the Mayoress have invited Members to a reception at Villa Marina at 8 p.m.

Saturday, 22nd September.

EXCURSION TO THE NORTH OF THE ISLAND.

Assemble at Villa Marina at 9.30 a.m. and leave there at 10 a.m. prompt.

(a) Proceed *via* Cloven Stones, Laxey (King Orry's Grave), Abbey Lands, Boulder with Bronze-age Spiral, Casthal Gorry, Ballachrink, Maughold Church (*al fresco* lunch) to Ramsey. Returning *via* Lezayre, Cronk Sumark, Bishops-court, Cronk Urleigh, Barregarrow, Pen-y-pot mountain road to Douglas.

(b) A Botanical excursion, under Mr. Hartley's guidance, to Ballaugh Currags. Both parties ('A' and 'B') meet at Bishops-court at 4 o'clock.

RECEPTION BY MUSEUMS TRUSTEES.

The Trustees of the Manx Museum will receive the Members in the evening in the newly-provided Manx National Museum.

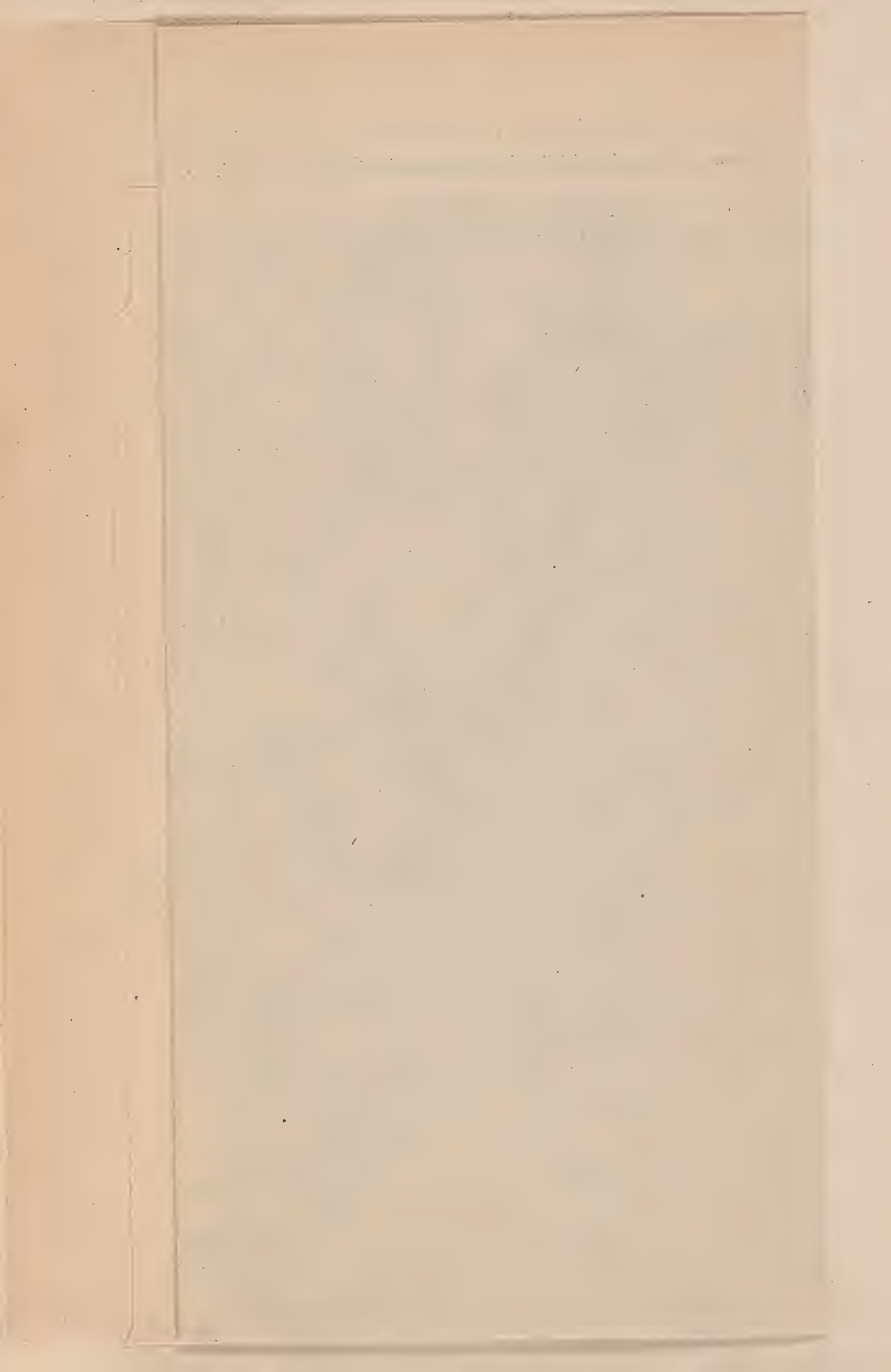
Sunday, 23rd September.

Church services in all the town Churches at 11 a.m., and open-air service at Kirk Braddan 10.30 a.m. Lunch at own hotels.

AFTERNOON EXCURSION TO THE NIARBYL AND
LAG NY KEILLEY.

Assemble at 2 p.m. at Villa Marina, and depart by motor coach at 2.15 prompt to the Niarbyl and Lag ny Keilley. Return to Douglas by 6 o'clock.

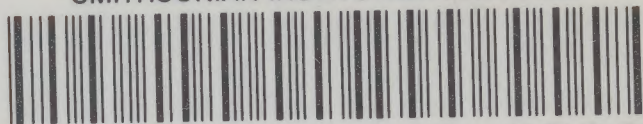
Provisional arrangements are being made for special facilities being granted by the Corporation and the proprietors of the various places of amusement for free admission to their evening entertainments.



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